(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE

140 NASSAU STREET, NEW YORK

J. S. BONSALL, Business Manager.
F. H. THOMPSON, Eastern Representative

R. V. WRIGHT, E. A. AVERILL, } Editors.

DECEMBER, 1909

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The paper has always been published for the greatest good of its subscribers and Mr. Van Arsdale has never allowed its editorial pages to be influenced by profit from the advertising section. He always held, and truly, that the greatest value to the advertiser could be obtained by a paper which was of the greatest value to its subscribers, and many times during his career it has been necessary to resist the temptation of very large profits in order to maintain this standard. He has not allowed the income from the advertising section of the paper to influence the amount or quality of the editorial matter, as is customary with most publications.

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AN EPOCH MAKING DINNER.

RAILWAY BUSINESS ASSOCIATION.

"An epoch making affair." Such was the enthusiastic expression of those who attended the annual dinner of the Railway Business Association at the Waldorf-Astoria Hotel on November 10th. And the men who expressed themselves thus were not carried away by the enthusiasm of the moment, but gave expression to these words after the affair was over and they had had time to calmly and deliberately study it. Among them were financiers of note, leaders in the manufacture of railway supplies, hard-headed business men and thoughtful and progressive railroad officials. What was it that had been done in one short year to bring this about and why such enthusiasm?

Briefly, two things:—First, it was demonstrated under the auspices of the Association that eminent railroad officials are anxious and studying to meet the public desires and that the railroad world generally, as well as the financial world, both elements being represented in large numbers and by their foremost leaders at the dinner, are ready and eager to acquiesce. Second, because the railway supply and equipment interests have for the first time come to a realization of their own economic and social importance when aligned as a common whole, and have become conscious of their dignity as a group of industries through the most convincing and satisfying process—namely, the complete realization of it by the railroads themselves.

* * * * * * *

As to the first point, listen to what W. C. Brown, president of the New York Central Lines, had to say in opening his address: "There was a time when the fundamental right of the nation and states to regulate and control its railroads was seriously discussed and questioned. Happily for all—the railroads as well as the public—this question is no longer open for debate. The question of the limitation of the right of regulation, the extent to which it should be exercised, is still open for discussion—not in a harsh or hostile spirit, not for the purpose of fixing by law an arbitrary point beyond which such regulation shall not go; but in a spirit of friendly co-operation to try and ascertain, in the interest alike of the public and the railroads, that happy mean which shall result in the maximum benefit to the patrons of the railroads and the minimum embarrassment in the way of restrictive regulation to the railroads of the nation."

Following is an extract from a letter of regret from Marvin Hughitt, president of the Chicago & Northwestern Railway: "If you succeed in convincing the public that the railroads desire to merit the good will and confidence of their patrons by honest, efficient service in the business of transportation, you will have accomplished much. I understand that especial emphasis will be laid upon that point at your dinner on November 10, and in your efforts in this direction you have my heartiest approval and endorsement."

President Ripley, of the Santa Fe, in his address on "The Railroads and Public Approval," emphasized the fact that the railroads stand ready to do their part in co-operating with the public to bring about the best results, in the following words: "Acknowledging as we must that the public is all-powerful, the question is, How may we satisfy our masters and thus mitigate our woes and preserve our properties?

"First. We must realize, as I think we all do (after a series of very hard knocks), that the railroads are not strictly private property, but subject to regulation by the public through its regularly constituted authorities—that the Government may reduce our earnings and increase our expenses has been sufficiently proved.

"Second. To meet this situation we must endeavor to get in touch with public opinion. Perhaps you will smile when I say that for years I have read every article on railroad matters in each of the papers published along our ten thousand miles of road—not an easy task for a busy man—but while I have waded through much chaff I am sure it has resulted in some reforms.

"Third. The avoidance of action seriously counter to public opinion except for compelling reasons.

"Fourth. The disposition to explain these reasons through officers and employees of all grades. Generally, the loudest criticisms come from those who are not anxious to know the truth.

"Fifth. Efforts to improve service in many cases without hope of reward and for the deliberate purpose of winning public approval, such as better stations, improved heating and lighting devices, better equipment, better terminal facilities, elimination of grades, etc.—all with due regard to the rights of those whose money we are spending."

* * * * * * *

As to the dignity and importance of the position of the railway supply man. One of the railway operating managers in attendance at the dinner said in a letter a day or two later:

"I believe thoroughly that the possibilities of the Association are but touched, and that the influences will be more far-reaching than any of us to-day can fully appreciate. I have always maintained that the railroads needed the supply man to precisely the same degree that supply men needed railroads. The former practically withdrew from the markets during the last two years, and railroad manufacturers felt it, but let the latter withdraw to the same degree, both as shipper and seller, for the same period of time, and a clamor would go up from the railroads which would result in forming an Association for fair play to the manufacturers because their absence would make their necessity appreciated.

"I am a railroad man and proud of that distinction, but I believe it is easier for some of us in the present generation to think straight on some of the present day problems than it is for men who have done most of their work under conditions which would often lead them to mistake the strength of the property which they were handling for their own individual strength, and while I do not believe that the Railway Business Association should ever be permitted to drift into an educational institution, it will be stronger with the public and will accomplish more good if it feels free to point out the errors of management and claims its proper proportion of the credit for invention which has brought about improvement in the railroad service and its right to participate in the financial benefits which should follow."

As President Post said in his address, "Sellers are as good as buyers, any day."

There can be no question that the relations, business and otherwise, between the railroad supply men and the railroad people have recently undergone a very healthful change. Nothing could better illustrate the attitude which the railroads are welcoming wherever it is manifested by the railway equipment business men than the address delivered at the dinner by W. H. Marshall, president of the American Locomotive Company. Mr. Marshall's address is reproduced in full in another part of this number.

Serving themselves by serving their customers in the fundamental matter of protecting their purchasing power, exerting themselves like business men in an economic effort to which as a body they have never before addressed themselves, the railway equipment and supply industries have entered upon a new phase and one which should be fraught with benefit to themselves, to the railroads and to the country.

THE GOSPEL OF EFFICIENCY

Another dinner was given in New York at about the same time as that of the Railway Business Association, which may be considered as marking an important mile post in the progress of industrial efficiency. The guest of honor was Harrington Emerson, well known because of his success as an efficiency engineer and as a disciple of Fred W. Taylor, who is a couple of generations ahead of his time, and whose ideas Mr. Emerson has modified to more nearly suit the conditions of to-day. The gathering was made up largely of young men who are associated with Mr. Emerson and by friends who have had the good fortune of becoming acquainted with and studying his work. It was probably the largest gathering of efficiency engineers that has ever assembled.

* * * * * * *

What is this efficiency system? Primarily it is designed to cut out all waste or lost motion by better organization, by the establishment of standards for the maintenance and operation of equipment and seeing that they are lived up to, and by the fixing of standard times for all operations and encouraging the men to attain them by paying a bonus or by the introduction of the individual efficiency system, as it is otherwise known.

* * * * * * *

Three thoughts were brought out at the dinner which are of importance to those interested in improving the efficiency of their departments or plants. The first one was a suggestion as to the solution of the problem of how to perpetuate and insure the permanency of the efficiency work. The second showed why some of the elaborate systems of welfare work among the workmen have proven worthless, and the third was an explanation of the reason why the so-called betterment engineers, not previously acquainted with the details of operation in a plant, can tell the men who have spent years in the business how to improve its efficiency.

* * * * * * *

As to the question of how to perpetuate the efficiency system. In the first place, this system is eminently fair to the workman in that his wages are based on his output, the reward for reaching or approximating standard time adding considerable to the amount in his pay envelope at the end of the week. It emphasizes the fact that labor and capital are dependent upon each other and that any injury to one must surely react upon the other. If the employee and the employer can be brought to a realization of this, then instead of both standing on the defensive they will co-operate closely to secure the best mutual results. Under these conditions the employer must rejoice as the strength of the labor organization increases and its influence is widened, and the agreements and understandings that will then be reached will practically insure the perpetuation of the efficiency system even though a change in management may place men at the head of the organization who do not understand or appreciate its advantages.

* * * * * * *

It is good business policy to look after the comfort and convenience of the workmen in order that they may be able to do their best work, but beyond this the so-called welfare work is useless unless based on a square deal to the men. The important thing is that the man receive a fat pay envelope at the end of the week and that the working hours be shortened as much as possible.

* * * * * * *

Most of us have doubtless wondered why it could be that men who know nothing of the details of operating a railroad shop or a manufacturing plant could in the capacity of betterment engineers greatly increase the efficiency of the plant with resulting increased dividends to the stockholders. One of the speakers who had made an intimate study of this question gave the following logical reason for it. It is quite possible for improvements to come from within the plant, but ordinarily they will not be radical ones, since the man who has been raised in the plant and understands every detail of its working will in making a change study its effect upon each of the other dependent details and operations and will not make improvements involving radical changes which effect the relation of all of the operations to each other.

One who comes from the outside and has had experience in other lines of work will look at the problem from a broad standpoint rather than that of detail operation and by utilizing his experience in other fields will solve the problem in an entirely different manner. Men who have been at the head of great reforms or who have put into practical use the great discoveries or inventions that have changed the world's history were not men who were brought up and established in the work in which their great achievement lay, but came from other fields and were better able to appreciate the possibilities of the new idea with which they came in contact.

RAILROAD CLUBS

Canadian Railway Club (Montreal).—W. S. Atwood, mechanical engineer of the Dominion Car and Foundry Company, Montreal, will read a paper on "Steel Freight Cars," at the meeting on December 7th. At the meeting for January 3rd, there will be a discussion on the Master Car Builder rules of interchange. Secretary, Jas. Powell, P. O. Box 7, St. Lambert, near Montreal.

Iowa Railway Club (Des Moines).—Next meeting Friday, December 10th. Secretary, W. B. Harrison, Union Station, Des Moines, Ia.

New England Railroad Club (Boston, Mass.).—Charles B. Edwards, of the Fore River Shipbuilding Company, Quincy, Mass., will read a paper on "The Curtis Turbine Applied to Marine Propulsion" at the meeting on December 14th. Dinner will be served at the Copley Square Hotel at 6:30, to be followed by the regular business session at 8 o'clock.

At the November meeting William J. Walsh, of the Galena Signal Oil Company, read a paper on "Lubrication of Railway Equipment."

Secretary, Geo. H. Frazier, 10 Oliver street, Boston, Mass.

New York Railroad Club (New York City).—The annual Christmas reunion and entertainment will be held in the Engineering Societies Building, Friday evening, December 17th. No technical paper will be presented. Secretary, Harry D. Vought, 95 Liberty street, New York City.

Northern Railway Club (Duluth, Minn.).—C. J. Whereat, traveling engineer of the Great Northern Railway at Superior, Wis., will present a paper on "Pooling Locomotives," at the next meeting, December 18th.

Secretary, C. L. Kennedy, 401 West Superior street, Duluth, Minn.

Railway Club of Pittsburgh.—The date of the December meeting has been changed to Wednesday, the twenty-second. R. B. Woodworth, engineer of the Carnegie Steel Company, will present a paper on "Tunnel Construction," principally of a sub-

aqueous character. As the rapid transit problem is again coming to the front in Pittsburgh it is expected that there will be a lively discussion of the subway question. The meeting will be held at the Fort Pitt Hotel. Secretary, C. W. Alleman, P. & L. E. R. R., Pittsburgh, Pa.

Richmond Railroad Club.—Chas. Stephens, signal engineer of the C. & O. Ry., will present a paper on "Block Signaling," at the next meeting, December 13th. He will be assisted by Mr. Johnson of the Union Switch & Signal Company. Secretary, F. O. Robinson, C. & O. Ry., Richmond, Va.

St. Louis Railway Club.—At the meeting on Friday, December 10th, C. R. Gray, vice-president of the St. Louis & San Francisco Railroad, will make an address.

Secretary, B. W. Frauenthal, Union Station, St. Louis, Mo.

Western Railway Club (Chicago).—Next meeting Tuesday, December 21. The subject has not yet been announced. At the November meeting in addition to Col. Dunn's paper on "The Transportation of Dangerous Articles," C. A. Seley, mechanical engineer of the Rock Island System, presented a paper on "Electrification of Chicago Railways." He showed the foolishness of the Chicago authorities in attempting to insist upon the electrification of the steam roads entering that city because of the effect upon the prevention of smoke; also that even if it would eventually pay the railroads to electrify, the local conditions are such that nothing should be done without the most careful and extended study and discussion.

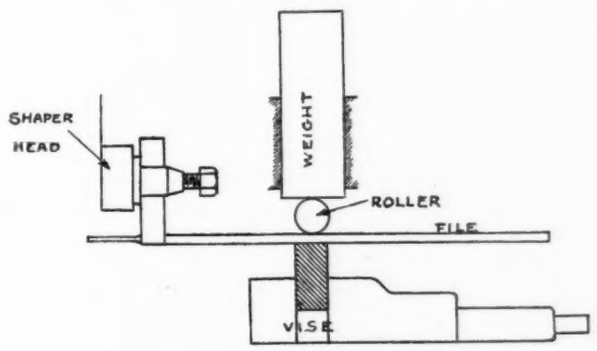
Secretary, J. W. Taylor, 390 Old Colony Bldg., Chicago.

Western Canada Railway Club (Winnipeg, Man.).—Next meeting Monday, December 13. Secretary, W. H. Rosevear, 199 Chestnut street, Winnipeg, Man.

EFFICIENCY OF FILES.

TO THE EDITOR:

Referring to the article on the efficiency of files, page 454 of your November issue. This is exceedingly interesting and instructive, but, like many other reports, it takes only the first step, namely, the making of records, and fails to take the second and more important step, the establishing of standards. It is interesting to know that a certain file when placed in the testing machine produces a certain curve, lasts a given number of strokes and removes a certain weight of metal, while another file produces an entirely different record in all these respects. However, it is far more important to establish a standard upon which to base the purchase of files. Which is the most economical file for a shop both as to original cost of the files and as to the cost of labor for producing a given amount of work? Shall we select the file which lasts the greatest number of strokes or the file which lasts fewer strokes, but produces more work while it lasts? Where shall the line be drawn between the life of the file and the time in which a given amount of metal is removed?



ATTENDANT LIFTS FILE ON RETURN STROKE

APPARATUS FOR TESTING FILES.

No elaborate testing machine is needed to establish such a standard. A simple arrangement used several years ago for establishing this standard is shown in the illustration. Files were purchased according to the standard thus established and produced a considerable saving for the shop.

RECORD OF TESTS.

No.	Time	Thickness of Test Piece.	Metal Removed.	Strokes Per Minute.	Length of Stroke.	Per cent. of Efficiency Compared with Standard.
1	1 Hour	15-16-in.	12.25-oz.	25	9-in.	100
2	"	"	5.7	"	"	46.5
3	"	"	6.7	"	"	54.6
4	"	"	7.5	"	"	61.2
5	"	"	4.0	"	"	32.6
6	"	"	5.25	"	"	42.8
7	"	"	4.25	"	"	34.7
8	"	"	4.25	"	"	34.7
9	"	"	5.25	"	"	42.8
10	"	"	6.25	"	"	51.0
11	"	"	6.25	"	"	51.0

The life of file No. 1 was not as long as that of No. 4, but was longer than that of the other files tested. However, the introduction of the labor cost immediately established file No. 1 as the standard.

	No. 1	No. 4	No. 5	No. 6 & 9
Price per dozen	$3.25	$3.20	$2.05	$2.05
No. of dozen used per year	375	346	494	400
Cost of files per day	$4.06	$3.68	$3.38	$2.73
No. of men required to produce same amount of work per day	20	32.7	61.3	46.7

As the difference in efficiency is in the files and not in the workmen, we can consider the men as paid at the uniform rate of $3.00 per day.

The cost of producing the same amount of work then becomes:

	No. 1	No. 4	No. 5	No. 6 & 9
Cost of files	$4.06	$3.68	$3.38	$2.73
Cost of labor	60.00	98.10	183.90	140.10
Burden as 40% on labor	24.00	39.24	73.56	56.04
Total cost	$88.06	$141.02	$260.84	$198.87
Excess cost by use of inefficient files		52.96	172.78	110.81

These tests therefore established a standard and determined that the most economical file to purchase was the one which would remove the most metal in the shortest length of time irrespective of the life of the file.

C. J. MORRISON.

30 Church street, New York City.

ENGINEMEN AS PASSENGER AGENTS.—Enginemen may become traffic solicitors by adopting advanced methods of handling engines, so as not to jolt passengers in starting or stopping their trains, avoiding reckless running, and by firing lightly, so as to prevent black smoke.

Some exceptionally good fuel records, equal to the average European railways, have recently been made by our engines—and if the average consumption of coal could be reduced to these special records the electrification of railways would be indefinitely postponed, because there would be no smoke nuisance, and the cost of operation by steam would be so low that the advantages of the electric railway would be removed. * * * There is no trick in it. All that is necessary is to take full advantage of your knowledge of the district over which you are running, and of your engine.

First—Shut off steam when it is not required.

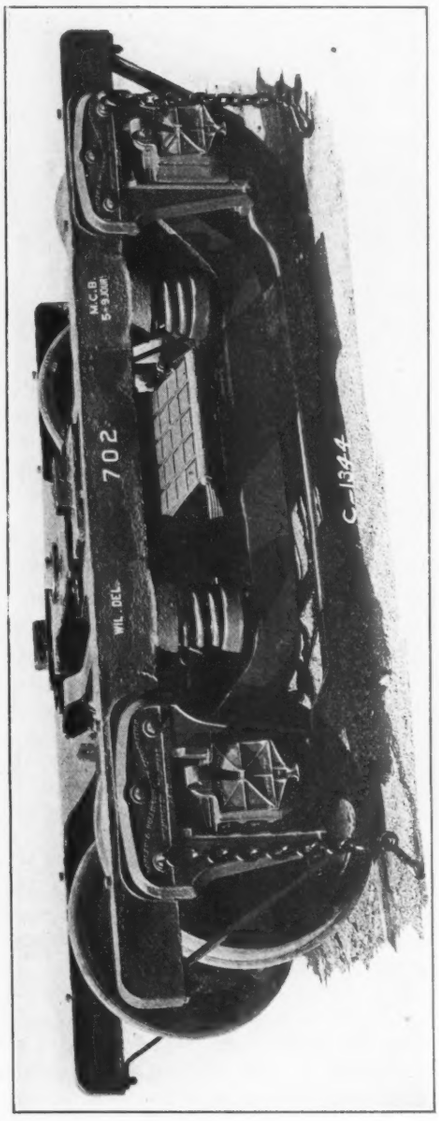
Second—Regulate the feed water, so that the supply will be just equal to the evaporation.

Third—Fire lightly, scattering the coal well over the grate bars, so that the dust and gases from each particle of green coal will be arrested and consumed instead of being thrown out of the stack in black smoke when the engine is fired heavily, or fed more than it can comfortably digest.—*Circular issued by J. Osborne, Supt. Canadian Pacific.*

STEEL UNDERFRAME COACHES.

Central Railroad of New Jersey.

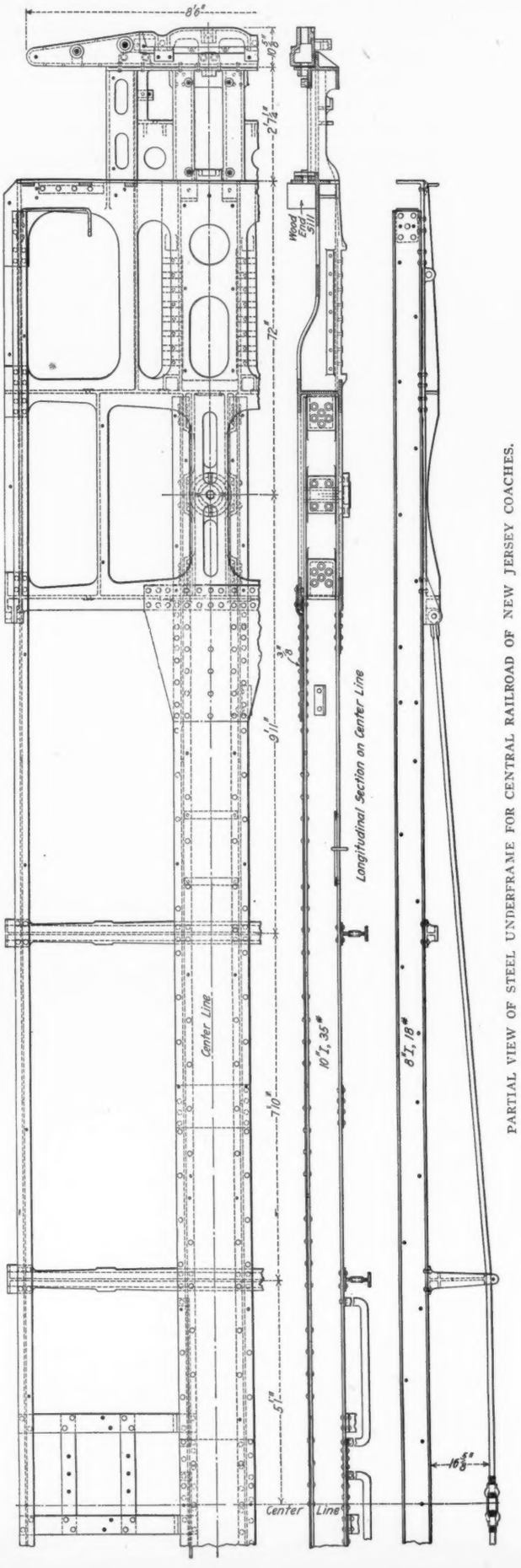
The Central Railroad of New Jersey has recently received fifteen coaches from the Harlan & Hollingsworth Corporation, of Wilmington, Del., which have steel underframes of a rather unique design. The end of the underframe, extending from a point 2 ft. 4 in. back of the center plate and including the center plate, double body bolster and platform, is in the form of a steel casting which was designed and built by the Commonwealth Steel Company, of St. Louis, Mo. The ends of the 10-in. I-beams, 35 lbs. to the foot, that form the center sills are securely riveted to these end castings. The I-beam center sills have a ¼-in. cover plate extending between the cast steel ends;



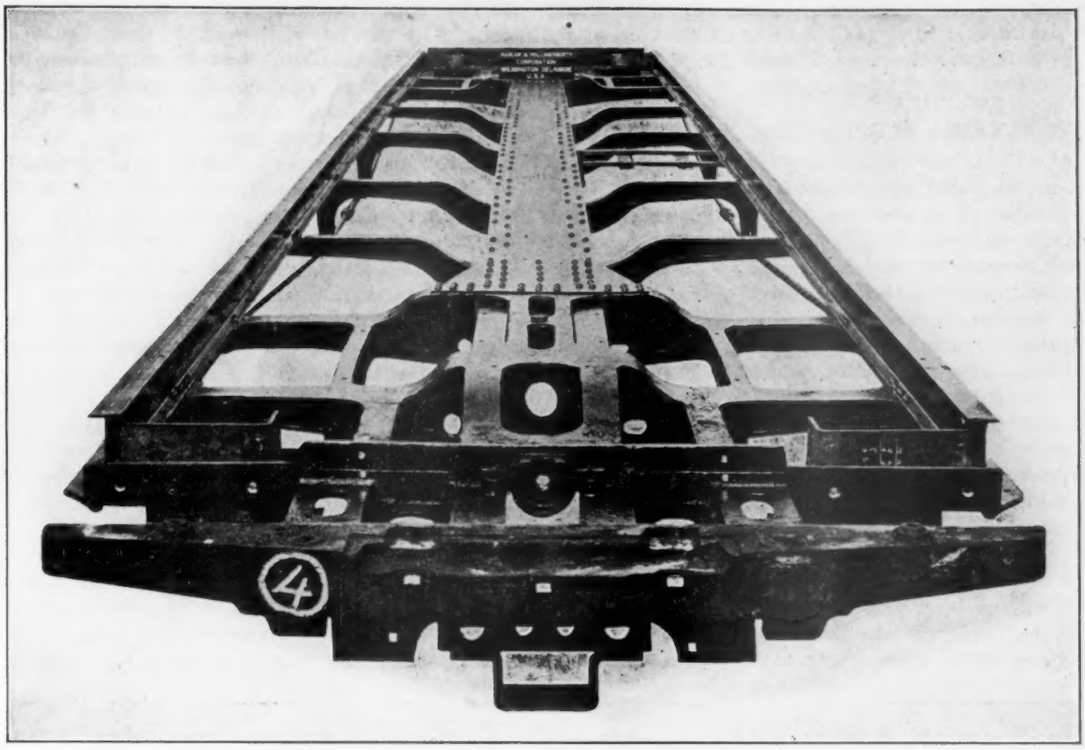
FOUR-WHEEL TRUCK FOR STEEL UNDERFRAME COACHES.

the connection between the center sills and end castings is reinforced by the ⅜-in. gusset plate, as shown.

The four cross bearers are of cast steel and extend underneath the center sills, and are riveted to them. The two near the center of the car are designed with ends to form queen posts for the 1⅝-in. truss rods. The side sills are 8-in. I-beams, 18 lbs. to the foot, and extend between the wooden end sills. As shown by the cross sectional view of the car, there are two intermediate wooden sills, 5 x 8 in. in section. The steel I-beams forming the side sills are covered with 4½ x 8-in. wooden timbers on the outside and 2 x 8-in. timbers on the inside. The floor and the wooden superstructure, which is of the usual construction, are secured to these wooden sills. Miner tandem



PARTIAL VIEW OF STEEL UNDERFRAME FOR CENTRAL RAILROAD OF NEW JERSEY COACHES.

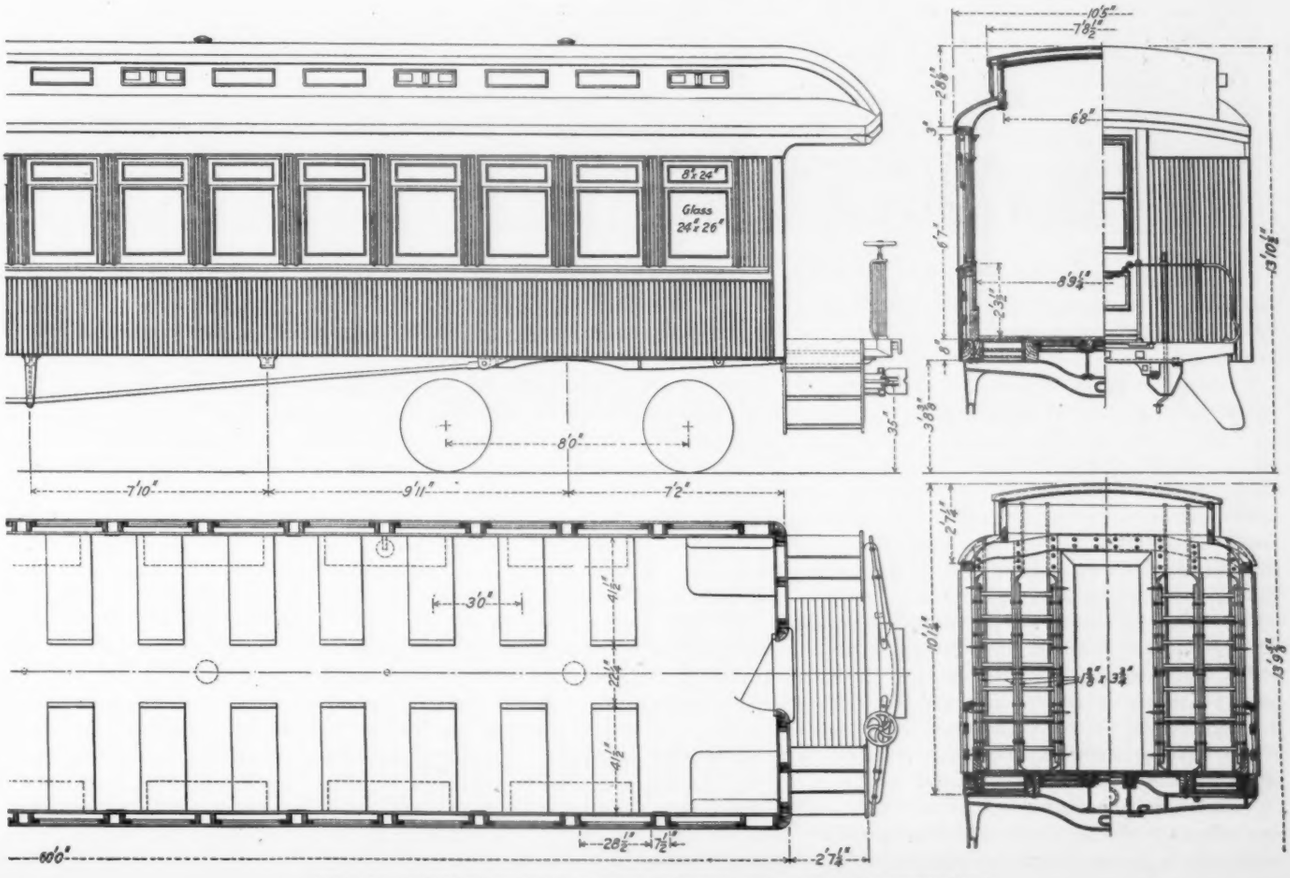


STEEL UNDERFRAME FOR PASSENGER COACHES, C. R. R. OF N. J.

draft gear is used in connection with a three-stem coupler. Following are the general dimensions of the car:

Length over end sills	60 ft.
Length inside	59 ft. 3½ in.
Width over side sills	9 ft. 8 in.
Width inside	8 ft. 10½ in.
Height from rail to top of car	13 ft. 10½ in.
Distance between truck centers	45 ft. 8 in.

The car weighs 90,000 lbs. and has a capacity for 74 passengers. The four wheel trucks have 36-in. forged steel wheels; the axles have 5 x 9-in. journals. The truck frame, bolster and spring plank are of cast steel, furnished by the Commonwealth



CENTRAL RAILROAD OF NEW JERSEY COACHES WITH STEEL UNDERFRAMES.

Steel Company. Waycott high speed brake beams are used. The car is lighted by Pintsch gas one-flame mantle lamps, furnished by the Safety Car Heating & Lighting Co., of New York.

PENNSYLVANIA ELECTRIC LOCOMOTIVES.

The first of the initial order for twenty-four electric locomotives, which are to be used for handling the Pennsylvania Railroad trains into the New York Station, has been delivered and is in operation on the electrified tracks of the Long Island Railroad. It is the result of several years co-operative development between the Pennsylvania Railroad Company and the Westinghouse Electric and Manufacturing Company and is distinctively a high powered machine, built for high speed operation.

In wheel arrangement, weight distribution, trucks, and general character of the running gear it is the practical equivalent of two American type locomotives coupled permanently back to back. The motors are mounted upon the frame and are side connected through jack shafts to the driving wheels by a system of cranks and parallel connecting rods, similar to steam practice. The connecting rods are all rotating links between rotating elements, and are thus perfectly counterbalanced for all speeds. The employment of this transmission permits the mounting of the motors upon the frame, secures their spring support, and, in common with the rest of the locomotive, the centre of gravity at approximately the same height above the rails found desirable in the best high speed steam experience.

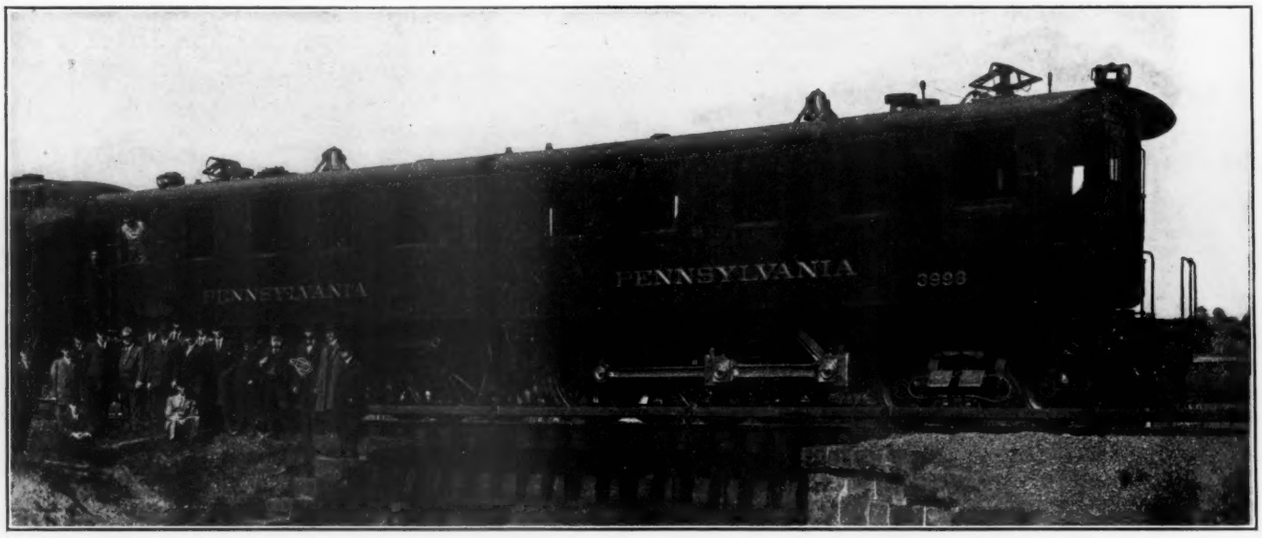
The same freedom of motion in the wheels and axles that is charactristic of the present steam locomotive is also secured. In these locomotives the variable pressure of the unbalanced piston of the steam locomotive is replaced by the constant torque and constant rotating effort of the drive wheel, and the pull upon the draw-bar is thereby constant and uniform. It might appear that by this arrangement of driving a return has been made to steam locomotive practice as regards counterbalancing difficulties, but it will, upon examination, be seen this is not true. There are no questions of unbalanced reciprocating weights involved; all weights are revolving ones and directly counterbalanced, so that as far as pounding upon the track is concerned, the effect is precisely the same as though the whole were driven without any pins or rods.

The starting requirements of this locomotive are unusually severe; it will be called upon to start a train of 550 tons trailing load upon the tunnel grades under the river, which are approximately two per cent. The guaranteed tractive effort of 60,000 lbs. is amply within the capacity of the electrical equipment. The normal speed with load upon a level track is 60 miles an hour, but the locomotive is capable of speed much in excess of this. The total weight of the locomotive is 332,100 lbs., of which 208,000 lbs. is carried by the drivers. At maximum capacity, it develops 4000 h.p. For sustained heavy output, the motors are designed for forced ventilation, but the initial service will not require this provision.

It will be seen that the locomotive is an articulated machine, and that each half carries its own motor and has four driving wheels 68 in. in diameter and one four-wheel swing bolster swivel truck with 36 in. wheels. Each section has its own cab of sheet steel extending the length of the frame, communication between the two cabs being provided through a standard Pullman vestibule. The rigid wheel base of each half is 7 ft. 2 in., and the total wheel base of each half is 23 ft. 1 in.; that of the whole locomotive being 55 ft. 11 in.

The running gear and mechanical parts were built by the Pennsylvania Railroad at their Juniata shops at Altoona. The electrical equipment was built and the apparatus assembled by the Westinghouse Electric and Manufacturing Company at their East Pittsburgh Works.

Frames.—The frames are of cast steel, of large cross section and massive construction, having an unusually high factor of safety. They are of sufficient strength to allow the engine to be raised by jacks, applied at fixed points provided in the construction, with all pedestal binders removed. The upper surfaces of the side frames are especially broad and furnish bases for the feet of the motor frames, which fit over the top members of the side frames with heavy flanges. There are five heavy crossties between the frames consisting of bumper, articulation and jackshaft girders, body bolster and drive wheel crosstie. Additional transverse strength is given by the steel motor frame which is bolted to the side frames.



ELECTRIC LOCOMOTIVE FOR HANDLING PENNSYLVANIA RAILROAD TRAINS INTO NEW YORK STATION.

The bumper and articulation girders are so proportioned that a bump equivalent to a static load of 500,000 pounds (150,000 pounds applied on centre line of draft cylinder and 350,000 pounds applied on centre line of platform buffer) will produce no stress exceeding 12,000 pounds per square inch in the frames. The jackshaft girder is of inverted U section, arranged to give rigid support to the jackshaft bearing brasses. It also carries upon facings the driver brake cylinder; the brake lever fulcrum is integral with the girder.

The crosstie between the driving wheels is of diagonal design, especially fitted for stiffening the bottom members, and also providing a base for the front driver brake hanger pin. This tie fits between the upper and lower members of the side frames and assists in rigidly supporting the heel of the motor frame. The articulation girder is unusually rigid diagonally in the horizontal plane and is designed to accommodate the articulation gear details. The body bolster carries the swivel truck

centre pin and is of ample strength to withstand all braking strains.

Wheels and Axles.—The driving wheels are 68 inches in diameter with tires 3 inches thick and have cast steel centres and rolled steel tires and are fitted with retaining rings. The truck wheels are of rolled steel 36 inches in diameter. The driving wheel centres are fitted with quartered crank pins and counter-balances; these latter are offset from direct opposition to the cranks to correct the transverse unbalance that would otherwise exist.

The axles, jackshafts and motor shafts are of special carbon steel, oil-tempered and annealed. They are of large diameter, finished all over and each has an axial hole throughout.

Cranks.—The motor shaft cranks are forged with integral counter-balances, accurately located in quartering positions and press-fitted and keyed to the shaft. The jackshaft cranks are forged integrally with the shaft in quartering position. Their counter-balances are keyed in position. As with the driving wheels, the counter-balances of the motor shafts and the jackshafts are offset from direct opposition to the cranks in order to complete the balance. All crank pins are of special carbon steel, oil-tempered and annealed, of ample diameter, bored axially and press-fitted to their respective cranks and wheels.

Connecting Rods.—The connecting rods are of special carbon steel, oil-tempered and annealed. Inasmuch as under the action of the brake shoes the wear of the axle and the take-up of the wedges in the pedestal tend to decrease the distance between the axle and the jackshaft, the main rod is adjustable at each end, so fitted that all take-up shortens the rod and furnishes compensation. The type of adjustable head is that employed on Pennsylvania Railroad Class E-3 locomotives. All other rods are fitted with solid bushed ends.

Draft Gear.—The bumper ends of the locomotive are fitted with Westinghouse friction draft gear, standard M. C. B. couplers and platform buffers of Pennsylvania Railroad standard type.

Articulation Details.—The articulation ends are fitted with permanent couplings of long twin drawbars and Westinghouse friction draft gears so designed that the leading half serves as a leading truck and the other half as a trailer in whichever direction the locomotive may be moving. The coupling gear is so designed as to oppose any possible "nosing" tendency or buckling action of the halves.

Spring Rigging.—The spring rigging is composed of equalizing beams, semi-elliptic springs, links and hangers of the usual type.

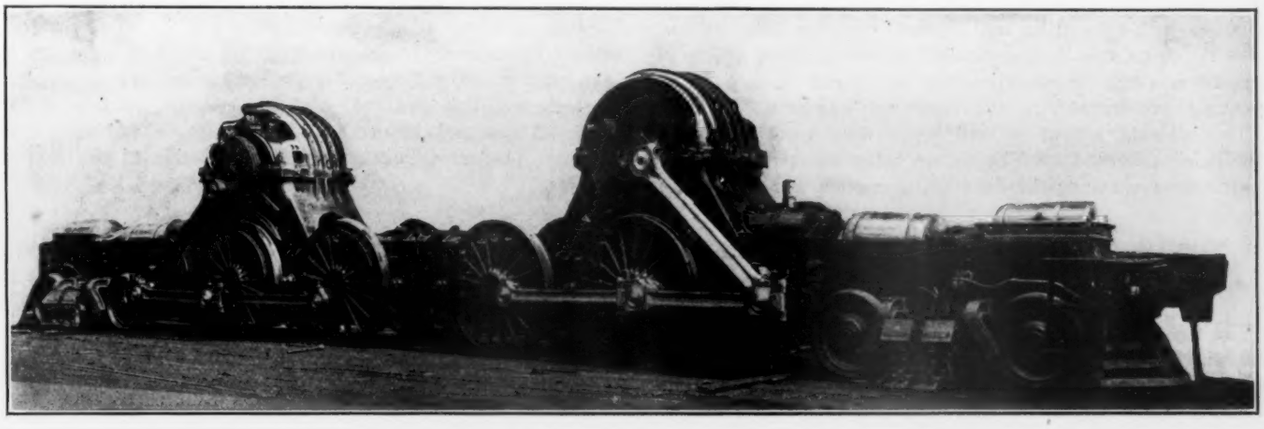
Cabs.—The cab of each half is an independent structure, complete in itself, so constructed that it may be lifted bodily from the running gear with the floor and all the auxiliary apparatus and set upon any convenient flat surface or trestle support without damage, leaving the motor and running gear accessible for any desired overhauling and permitting attention to be given at the same time to the machinery in the cab. The cabs are identical in construction and fittings, and so arranged that they are interchangeable.

The location of the cabs in assembling is determined by dowels fitting in corresponding holes in the running gear. They are held in place by a number of bolts sufficient for security. The cabs are amply lighted by electric lamps. Bulkheads and doors are so arranged that the motor and air compressor compartments, containing nearly all of the auxiliary apparatus, may remain lighted at all times with no intrustion of light in the controller compartment to affect the vision of the driving engineer. Provision is to be made for heating the cabs by steam furnished from electric steam boilers within the cabs.

Each cab is fitted with an overhead collector of the pantagraph type, located on the roof, for power supply over gaps of the third rail in the yards. The sanders and overhead collectors are operated by foot push buttons located near the master controller within easy reach of the driving engineer.

Headlights.—Each cab carries on its own roof, at the end, an electric headlight having for its illuminating element a 50 c.p. stereopticon lamp operated from the main current, with suitable resistances, on 240 volts. These headlights are not intended to be of high candle power, or to have a searchlight quality, although they might readily have been made so, as the electric current is at hand. It was considered of great importance to avoid the blinding effect on the motorman of a powerful light,

Air Brakes.—Each half is supplied with complete Westinghouse air brake equipment actuated by a motor driven air compressor and a 600-volt motor for both automatic and direct braking of locomotive and train. The compressor also furnishes air for the electro-pneumatic switches and its displacement is 65 cubic feet of free air per minute. The entire system is especially designed for these locomotives and the foundation brake rigging is suitably proportioned for the weights and arranged for delivery of 85% braking power at 50 pounds cylinder pressure.



ELECTRIC LOCOMOTIVE WITH CABS REMOVED, PENNSYLVANIA RAILROAD.

ELECTRIC EQUIPMENT.

The motive power is delivered from two interpole motors on direct current at 600 volts. The design of these motors was governed by the necessity of commutating the heavy draughts of power required to accelerate the heavy trains on the tunnel grades. For this purpose the design not only affords great electrical stability but renders it possible to use the economical, flexible and efficient field control. Each motor will develop 2,000 h.p. on a current of 2,900 amperes at 600 volts. The weight of each motor complete without crank is 42,000 pounds.

The motor frames are cast steel shells divided horizontally and bolted rigidly together. The motor is of open construction affording easy access to all parts. It is especially provided with powerful self-ventilation. If the full power of the locomotive is to be used more frequently than contemplated, ventilation by air blast can be used to greatly increase the output. Semi-circular openings in the lower half of the frame provide seats in

which the bearing housings are rigidly bolted. The lower half of the frame is provided with four feet for mounting and bolting on the side frames of the running gear, and these feet have machined flanges fitting over the top members on the side frames and stiffening the structure against transverse movement on the part of the motors. In addition to being securely bolted, the feet of the frame are firmly wedged in place.

The motors have ten main poles and ten interpoles, with heavy strap field windings. The main field is split in two halves, both being used together in slow speed operation. One of these sections is shunted in control. The armature core is built of soft steel punchings assembled with the commutator. The commutator bars are of hard drawn copper clamped by cast steel rings over mica insulation. For relief of the driving mechanism from excessive strains in the event of short-circuit in the powerful motors an adjustable friction clutch of novel design and tested efficiency in action is provided between the armature spider and the motor shaft.

Third Rail Shoes.—Each half unit is supplied with two pairs of rail shoes of appropriate size and strength, suitably connected and fused. One pair of shoes is mounted on a hard wood beam on each side of the swivel or four-wheel truck.

Control.—The control is of the Westinghouse shunted field control, and by utilization of the unit-switch system the motors may be grouped in "series" or in "multiple" at will. Electro-pneumatic switches, actuated by air from the brake compressor and operated by magnets controlled from the master controller, are provided to regulate the field strength of the motors by shunting and by cutting out a portion of the field winding, in addition to the "series parallel" grouping, thus giving increased economy of operation and additional running points, greatly improving facility and economy of operation.

The bridging system is used for passing from "series" to "multiple" connections. The motor fields are arranged to be reversed for changing the direction of motion and reversing is accomplished by unit switches. The master controller is simple in operation and the cab is so arranged that the entire controlling mechanism of the locomotive and train is within reach of the driving engineer.

While it is not intended that the half units be operated independently, the cabs are identically equipped and the windings, connections and control are such that in the event of the disabling of one motor the train may be operated under reduced power by the second motor, the same resistances being employed as for the two.

A master controller with latches handle and suitable operating points is placed in each end of the locomotive and the circuits thereto are so arranged that when two or more locomotives are coupled together all may be operated simultaneously from any one of the master controllers. All switches are operated from the master controller entirely at the will of the motorman or engine driver. The resistances are of the three-point cast grid type. The grids have such capacity that when one motor is cut out of service the locomotive will operate with the remaining one. Under such circumstances the locomotive will exert a tractive effort of 25000 pounds with the train accelerating at a rate of one-tenth mile per hour per second until the resistance grids are cut out.

Suitable receptacles and jumpers are provided to establish the necessary low voltage control circuits between the locomotive half units and between the adjacent locomotives. A duplicate set of small storage batteries is supplied in each half unit for operation of the control circuits; and relays with suitable resistances are provided for shunting part of the current of the compressor motor through the batteries for automatic charging. An exceptionally quick-acting circuit-breaker is supplied on each half unit and connected between the junction of the third rail shoe and the overhead collector cables and the switch groups. The main switch is on the line side of the circuit-breaker.

THE HEAT TREATMENT OF SPRING STEEL.*

LAWFORD H. FRY.

The following is an account of a series of tests made at the Baldwin Locomotive Works in 1907, to determine the effect of certain heat treatments on the transverse elastic limit, and on the modulus of elasticity of the steel commonly used in America for locomotive carrying springs. The points under investigation were:

1. The effect of annealing.
2. The comparative effect of quenching in water and in oil.
3. The effect of reheating the steel to various temperatures after complete cooling in water or in oil.

The steel experimented upon was basic open hearth spring steel, furnished by the Carnegie Steel Company, and its chemical composition was:

	Per cent.
Carbon	1.01
Manganese	0.38
Phosphorus	0.032
Sulphur	0.032
Silicon	0.13

The test pieces used were 1 in. in diameter and 14 in. long, with a uniform circular cross section. Ten test pieces were cut from the same bar of steel, stamped with Nos. 11 to 20 and treated as indicated in Table I, which also shows the effect of the treatment on the physical quality of the steel.

METHOD OF HEATING AND COOLING THE TEST PIECES.

In the experiments, the temperature at which the specimens were quenched was not varied, as experience has shown that there is a definite temperature for any given steel, size of work and method of quenching, at which the steel should be quenched to obtain the best results. Steel can be hardened by heating it to and quenching it at any temperature equal to or higher than its "critical point," but the higher the temperature at which it is quenched the coarser becomes the grain and the more brittle the steel. It is, therefore, desirable to quench the steel close to the critical point, but in practice it is found necessary to allow a certain margin above the theoretical hardening temperature. This margin above the critical point is affected by the sizes and shape of the work and the method of quenching. Having been once determined this proper quenching temperature should be always used, any variation in the final degree of hardness being produced by a change in the temperature at which the temper is drawn, or the heat conductivity of the quenching bath.

By means of a magnet the "critical point" or point of recalescence of the steel experimented upon was found to be 1,360 degrees F. Previous experience with the steel has shown that for annealing, the steel should be heated to 40 or 50 degrees above the critical temperature, and that for hardening it should be brought to 50 or 100 degrees above the critical temperature, the exact temperature being determined by the size of the work and the effectiveness of the cooling bath.

For the present investigation the following temperatures were decided upon, they having been indicated by previous experience to be the most desirable:

	Degrees F.
For annealing	1,400
For quenching in oil	1,450
For quenching in water	1,425

All the operations were carried out at these temperatures, and the heats at which the temper was drawn and the mode of quenching were the only variables in the heat treatment. The test pieces were heated in a lead bath specially constructed to secure control and uniformity of temperature. The lead was contained in a cast iron pot placed in a circular brick lined furnace. Six burners uniformly spaced admitted a gas blast at a tangent with the brick walls, so that the flame rotated around the lead bath without impinging upon it at any point. The temperature of the lead bath was registered by means of a Bristol electric pyrometer.

* A paper read at the Copenhagen Congress of the International Society for Testing Materials, September 7-11, 1909.

For annealing, the test pieces were plunged in the lead, the bath heated to 1,400 degrees and kept at that heat for two hours, and then allowed to cool off naturally with the furnace, the top of the pot being covered. The time of cooling was 14 hours.

For hardening the test pieces were brought to the temperature indicated above and then quenched: 1, In oil at a temperature of 80 degrees F., the oil conforming to the Baldwin Locomotive Works specification for tempering oil, which requires a fire test of 600 degrees F. or over, and a specific gravity of not less than 25 degrees B. at 60 degrees F.; or, 2, in pure running water at 60 degrees F. The test pieces while being quenched were kept agitated until cooled to the temperature of the bath.

For drawing the temper up to 600 degrees F., the test pieces were placed in an oil bath heated by gas, the temperature being registered by means of a mercury thermometer; for drawing the temper above 600 degrees F. the test pieces were placed in the lead bath, the temperature being registered by the Bristol pyrometer. After the temper was drawn to the desired temperature, the test pieces were taken out of the bath and left to cool naturally in the air.

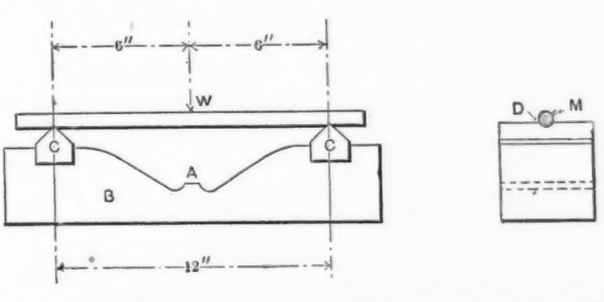
Table 1.—Results of Tests of Spring Steel.

No. of tests.	Heat treatment.	Elastic limit. Pounds per square inch.	Modulus of elasticity	Diameter of test piece. Inches.	Moment of inertia.	Breakage deflection.—Inches.
17	Annealed in lead at 1400° F.	78,500	27,550,000	0.991	0.04730	Did not break.
11	Hardened in oil at 1450, drawn to 560° F.	137,500	28,700,000	1.000	0.04909	Did not break.
14	Hardened in oil at 1450, drawn to 500° F.	160,400	27,150,000	1.000	0.04909	Did not break.
19	Hardened in oil at 1450, drawn to 400° F.	177,600	29,080,000	0.991	0.04730	Did not break.
12	Hardened in oil at 1450° F., not drawn	187,400	28,610,000	0.993	0.04772	Did not break.
16	Hardened in water at 1425, drawn to 1050° F.	180,700	28,070,000	0.997	0.04850	Did not break.
13	Hardened in water at 1425, drawn to 900° F.	233,900	28,860,000	0.998	0.04870	Did not break.
15	Hardened in water at 1425, drawn to 750° F.	240,800	29,220,000	0.994	0.04790	0.744
20	Hardened in water at 1425, drawn to 600° F.	219,800	30,420,000	0.991	0.04730	0.175
18	Hardened in water at 1425° F., not drawn.	212,000	29,960,000	0.991	0.04730	0.175

Test pieces 17, 11, 14, 19, 12, 16, 13 did not break under a deflection at the middle of 1.1 inch.
Test pieces with uniform round cross-section placed on supports 12 in. apart, load applied in middle. Chemical analysis of steel used: Carbon, 1.01; phosphorus, 0.032; manganese, 0.38; sulphur, 0.032; silicon, 0.13.

METHOD OF TESTING.

All the specimens were tested transversely. They were placed on supports 12 in. apart and the loads applied in the middle. The arrangement of the forged steel base B and the tool steel blocks C is shown in the sketch. The bottom of the base was carefully planed and finished and the tool steel blocks C, supporting the specimens, had been scraped to fit the base exactly, so as to allow of no play or deformation when the loads were applied. The top of the tool steel blocks was rounded off at D, to the shape of the test pieces, so as to give a good bearing; but even so it was found that the blocks would cut into the test pieces 0.001 or 0.002 in., and in order to remove as far as possible any error in the measurement of the deflections due to this cause, the specimens were subjected, before the test was begun, to the repeated application and release of a load which stressed them to about two-thirds of the elastic limit. This load was applied and released often enough to seat the test piece on the supports, without giving it a permanent set. When the test piece was seated, the test proper was begun, and the height and deflections of the bars measured at their centers, with an inside micrometer, measuring 0.00001 in., one point of which rested in a small center punch hole in the base, shown at A. The deflections were increased by steps of 0.0005 in. at a time and the loads measured for each increment of deflection. After having begun a test, the test piece was not released until the test was ended, as this was found to be the most accurate method; there is, therefore, no record of the permanent sets above the elastic limit.



COMPUTATION OF RESULTS.

The results obtained are shown in Table I. The elastic limit is that point where the ratio of deflection to stress ceases to be appreciably constant, and the deflection begins to increase at a faster rate than the stress. The fiber stresses, elastic limit and modulus of elasticity were calculated from the usual formulæ for a simple beam supported at both ends and loaded at the middle as follows:

$$S = \frac{Wlc}{4I} \quad \ldots (1) \quad f = \frac{Wl^3}{48EI} \quad \ldots (2) \quad E = \frac{Wl^3}{48fI} \quad \ldots (3)$$

and combining (2) and (3)

$$f = \frac{Sl^2}{12Ec} \qquad E = \frac{Sl^2}{12fc}$$

where

S = maximum fiber stress in pounds per square inch.
W = load in middle in pounds.
l = span = 12 in.
I = moment of inertia of cross section $= \frac{\pi d^4}{64}$ for a round section.
f = deflection in the middle in inches.
E = modulus of elasticity.
c = distance of neutral axis to outermost fibers $= \frac{d}{2}$
d = diameter of test pieces in inches.

DISCUSSION OF THE RESULTS.

Annealing.—The steel used in the tests, when thoroughly annealed in the manner above described, had an elastic limit of 78,500 lb. This, as shown below, is equal to about one-half the elastic limit generally obtained with this steel when given a "spring temper," and is equal to about one-third the elastic limit of the same steel when quenched in water and drawn to 750 degrees F.

Oil Hardening.—The highest elastic limit obtainable with the steel used, when quenched at 1,450 degrees F. in oil, was 187,400 lb. per square inch, and this was obtained when the temper was not drawn after quenching. The higher the temperature to which the temper was drawn, the lower the elastic limit fell. Drawing to 400 degrees F. gave 177,600 lb., drawing to 500 degrees F. gave 160,400 lb., and drawing to 560 degrees F. 137,500 lb. per square inch elastic limit. None of the oil-treated specimens broke under a 1.1 in. deflection. The usual "spring temper" given in shop practice would be: Quenching from about 1,450 degrees F. in oil and drawing the temper to between 400 degrees and 575 degrees F. It will be seen that this practice would give an elastic limit varying from about 130,000 lb. to about 175,000 lb. per square inch, and an average of about 150,000 lb. per square inch.

Water Hardening.—When the steel was quenched at 1,425 degrees F. in water and the temper not drawn after quenching, the steel was brittle and broke at 212,000 lb. modulus of rupture, the elastic limit being the same as the modulus of rupture, and the deflection of the breaking point being 0.171 in. (The term "modulus of rupture" has a conventional meaning. It expresses in pounds per square inch the apparent maximum fiber stress, tension or compression of a member transversely loaded, as it is

just on the point of breaking; the stress being calculated by the common beam theory, with its three important assumptions, which are known to be inaccurate above the elastic limit.)

Drawing the temper to 500 degrees F. gave an elastic limit of 219,800 lb., with the elastic limit still equal to the modulus of rupture; or, in other words, the ratio of stress to strain was constant up to the breaking point. The deflection at the breaking point was 0.175 in. Drawing the temper to 750 degrees F. gave the highest elastic limit, 240,800 lb. per square inch, and the modulus of rupture was then higher than the elastic limit, viz., 389,000 lb. per square inch. The deflection at the breaking point was 0.744 in. If the temper was drawn to 900 degrees F. the elastic limit fell slightly, being 233,900 lb. and the specimen did not break under a 1.1 in. deflection. When the temper was drawn to 1,050 degrees F. the elastic limit dropped to 180,700 lb. and the test piece did not break under a 1.1 in. deflection.

The Modulus of Elasticity.

The results of the tests show that the modulus of elasticity is practically constant, and apparently independent of the heat treatment given. The modulus of elasticity is difficult to determine accurately, on account of the precision required in measuring the deflections and loads, which vary by very small amounts. It is to be noted that any error in the measurements is likely to make the value of the modulus smaller than it really should be. The modulus of elasticity is the ratio of the stress to the strain, or in this case the modulus of elasticity, E, varies as $\frac{\text{stress}}{\text{deflection}}$ Now, all measurements of the deflections have a tendency to be too large and consequently the values found for E have a tendency to be too small, because the blocks and base on which the specimens rest are compressed to a certain amount by the loads on the test pieces, and if not perfectly fitted the blocks take a certain set which, together with the compression of the support, is measured with the true deflection of the test pieces and added to the true deflection in all the computations. Also, the softer the test pieces the more difficult it is to prevent the supports from denting it under load. The values obtained for the modulus of elasticity varied from 27,150,000 to 30,420,000. It would seem that the higher values are more probably correct, and that the true modulus of elasticity of the steel apparently lies between 29,000,000 and 30,000,000 and is probably unaffected by the heat treatment.

Conclusions.

Steel of 1 per cent. of carbon, when quenched in cold water from above its "critical point," is usually too hard and too brittle to be used for the making of springs or tools. The theory of the hardening of steel tells us that there are two ways of modifying this hardness and brittleness of the steel. They are: First, allowing some of the carbon fixed in the "hardening" form by quenching, to change back to the "annealing" form, by reheating the steel above 400 degrees F. The higher this reheating or "drawing of the temper" is carried, the softer the steel becomes; second, using a quenching bath having a lesser heat conductivity. The slower the steel is cooled from above the "critical point" to about 400 degrees F., the more carbon is allowed to change to the "annealing" form and the less the steel hardens. By the second method, steel can be obtained of different degrees of hardness without "drawing the temper" after hardening the steel. These two methods of regulating the hardness of steel in hardening can also be used jointly.

These points are illustrated in the tests. The higher the temper is drawn after hardening the lower the elastic limit falls; also a lower elastic limit is obtained with the test pieces quenched in the bath having the lesser heat conductivity, viz., oil. The tests show that the elastic limit of 1 per cent. carbon steel can be made to vary from 78,500 lb. per square inch to 240,800 lb. per square inch by changes in the heat treatment, and that very small changes in the "drawing of the temper" are sufficient to effect the elastic limit of steel. This proves once more that the heat treatment of steel is a delicate and accurate operation, and that to obtain good and uniform results it is necessary to have means of heating the steel uniformly to the proper temperature and cooling it at the desired rate in a cooling medium, the temperature and heat conductivity of which can be kept reasonably constant.

FLEXIBLE STAYBOLTS—A CRITICISM.

To the Editor:—

The writer has been much interested in the different papers written on the subject of "flexible stays," particularly those before the American Society of Mechanical Engineers. It would seem to me that a large amount of the time spent on the study of relieving stays by flexibility has been wasted, since the real meaning of a stay is to "hold fast," and if it is made partially flexible it cannot "hold fast," the way in which the meaning of the "stay" is intended to convey.

It seems to me that staybolt maintenance will continue to be a source of anxiety to the motive power department as long as present construction exists. No one can conclusively certify to the exact conditions of the strains set up in the firebox plates, due to the expansion and contraction, and if it is assumed that the strains go in a direct line, and an attempt is made to relieve them by using a flexible stay, it will be found that when the allowance has been made to take care of the strain in one part of the plate, it will crack in exactly the opposite part.

This question of breaking stays and cracking firebox sheets and tube plates is surely a problem, but from my own experience my opinion is that an attempt to solve it by studying the design of staybolts will be of little use. I have come to the conclusion, after long study, that the only way of getting rid of the present strains set up in the plates is by the proper formation of the sheets themselves and to so construct them that the expansion and contraction from the front tube plate to the back of the firebox will be as nearly balanced as possible. By flanging to accomplish this we not only relieve the strains on the staybolts but also increase the direct heating surface in the firebox, which is of course an important advantage, as it is done without enlarging the grate surface.

The writer, in studying this subject, made quite a number of experiments on different shapes in order to find out what flexibility could be put into the plate itself between each row of staybolts. It was finally found that on a 5 in. section, 1 in. wide, curved to a depth of 1¼ in., a pull of 900 lbs. would elongate it 1-20 of an inch. From these experiments the writer was satisfied that by flanging between each row of staybolts, covering the sides and crown in one plate, starting at the first row of staybolts from the mud ring, and returning thereto would practically neutralize all the strains that were set up in the firebox. It will be seen that the stay in this case is of no great importance. The construction, however, permits an increase in the diameter of the staybolts from 1 in. to 1⅛ in., and the centres of the stays can be increased to in. instead of 4 in., thus reducing the number by from 300 to 350.

I have also made a large number of experiments on relieving the strains of the tube plates by flanging, and giving them flexibility permitting the front and back tube plates to work together, and allowing the tubes to expand and contract en masse, thus reducing tube leakage and preventing cracking of plates.

Large consolidation boilers have been working, with these improvements, under 200 lbs. steam pressure for nearly one year, and have not broken a single staybolt, from which it would appear that the mode of formation and flanging has neutralized all the strains set up in the firebox, as well as taking all the tension off the mud ring, thereby preventing mud-ring troubles, leaky stays and tubes, and effecting a large saving in fuel from the increased heating surface. It would appear that the balancing of the expansion and contraction in these boilers, from the front tube plate to the back of the firebox, has practically been realized, and with reasonable care being used in dumping the fire at terminals, these boilers would run indefinitely without having an expander put in any of the tubes.

From actual experience it has also been found that fireboxes

with these formations do not scale any more than fireboxes with plain surfaces.

In conclusion, it was stated in a discussion before the American Society of Mechanical Engineers, that the trouble of staybolts in high pressure locomotive boilers is a permanent factor in the cost of locomotive maintenance, and has an important bearing on the safety of the public. Any innovation intended to increase their durability or reliability is, therefore, worthy of the most careful demonstration and service trial.

WILLIAM H. WOOD, *Engineer.*

Media, Del. Co., Pa.

CALIBRATING APPARATUS FOR HIGH PRESSURE GAUGES.

The bursting of machine parts and fittings from excessive pressure is usually accompanied by considerable danger, expense and delays for repairs. This is especially true with the extremely high working pressures under which liquids and air are often used. It is therefore quite important to know the pressure conditions within any apparatus using these sources of power and the gauges should be calibrated at regular intervals. Under the higher hydraulic pressures the same gauge will frequently show different percentages of error at different pressure readings, and these can be compensated for in ascertaining the true pressure only by comparing with a "master" gauge of known accuracy or by loading with a known pressure. The apparatus shown in the illustration performs these two functions of testing by comparison with a master gauge and of testing the accuracy of the master gauge.

CALIBRATING APPARATUS FOR GAUGES.

For the first purpose, only the part on top of the stand is required. This consists primarily of a cross made of hydraulic bronze. The gauge to be tested, which may register any pressure up to 16,000 pounds per square inch, and the master, are attached to the front and back ends of the cross respectively. At the left is a crank-operated screw displacement piston, by means of which the desired pressure may be produced within the pressure chamber. A suitable stuffing box prevents leakage past the piston. To the right end is connected a stop valve and filling cylinder. This permits some of the liquid to be withdrawn from the pressure chamber before removing the gauge being tested and filling after a gauge is put on. There is thus no danger of spilling the oil.

For testing the master gauge, the special weight-loaded hardened and ground steel piston and cylinder are attached at the right by means of flexible copper tubing, as shown. These parts are cut out by a stop valve when not testing the master. The cylinder is long enough to have the center of gravity of the weight below the center of support. When the weights are revolved the friction due to lifting the weights is practically eliminated. The apparatus is made by the Watson-Stillman Company, of New York.

GAS-ELECTRIC MOTOR CARS.

The General Electric Company has sold to the Southern Railway Co. two of its latest type of gas-electric motor cars. These cars will be equipped with standard commutating pole railway motors of 100 h.p. Two of these motors are located on the forward truck, giving a motor capacity of 200 h.p. to each car. The current is supplied from a 600 volt generator, which is direct coupled to an 8-cylinder gas-engine in the forward compartment. A controller similar to that used on an ordinary trolley car is located convenient to the operator, and through this the current passes from the generator to the motors. Combined straight and automatic air brakes will be provided with the usual valves and accessories. The car bodies will be of steel, about 55 ft. long, with a seating capacity of 52 passengers. Both rear and center entrances are provided, thus furnishing a convenient means of dividing the two classes of passengers, as required in the South. The car bodies will be illuminated by electric light throughout. The order for these cars was placed with the General Electric Company after a thorough test of this type of car between Manassas and Strasburg last summer.

M. M. & M. C. B. CONVENTIONS.

The executive committee of these associations has decided to hold the Master Mechanics' and Master Car Builders' conventions on the Million Dollar Pier, at Atlantic City, from June 15 to 22, 1910. The Master Car Builders' Convention will be first and will begin on Wednesday; the Master Mechanics' will open on the following Monday. The plan to bring both into one week did not carry. Headquarters will be at the Marlboro-Blenheim hotel. The permanent secretary of the Supply Men's Association is J. D. Conway, late chief clerk to the superintendent of motive power, Pittsburgh & Lake Erie Railroad. His headquarters will be in Chicago. The exhibits committee consists of B. E. D. Stafford, S. P. Bush and C. D. Storrs. The total space available for exhibits this year will be 69,000 square feet, an increase of 11,000 square feet over last year. The space charge will be forty cents per square foot.

LOCOMOTIVES FOR THE PENNSYLVANIA LINES WEST.—The 1910 schedule for new locomotives of the Pennsylvania Lines West of Pittsburgh includes 30 Class K2 passenger engines, 13 Class B6 switching engines, to be built at the Juniata shops; 50 Class H8a freight engines to be built by the Baldwin Locomotive Works, and 5 Class H8a freight engines and 27 Class B29 switching engines to be built by the American Locomotive Company. This makes a total of 125 locomotives.

INSURANCE FOR EMPLOYEES.—The B. F. Sturtevant Company, Hyde Park, Mass., has established at its works a branch of the Massachusetts Savings Bank insurance. The work is in charge of an instructor who goes among the men explaining the necessity and value of systematic saving. A large number of their employees have taken advantage of this proposition, arranging for insurance to amounts varying from $500 to $1,000.

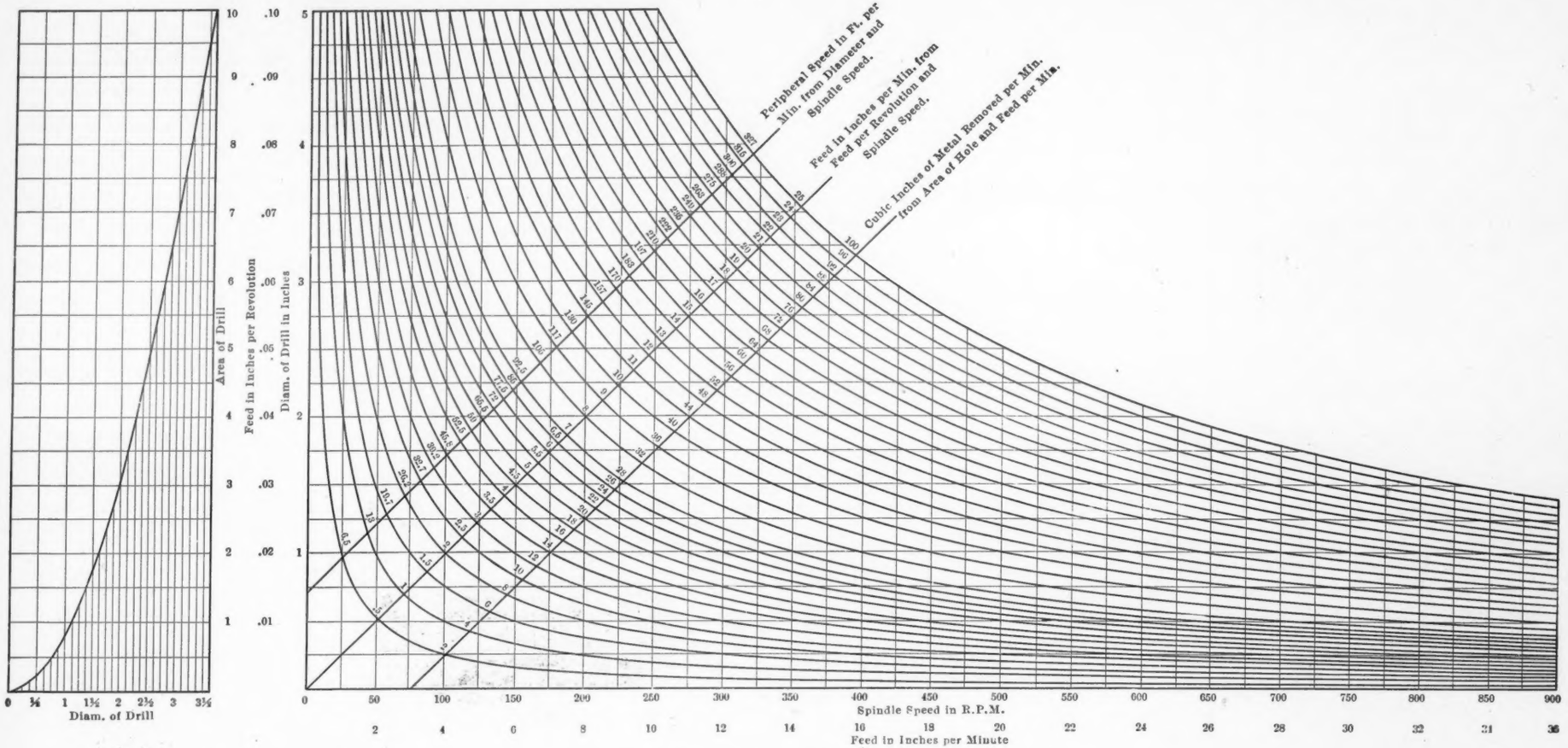

Peripheral Speed in Ft. per Min. from Diameter and Spindle Speed.
Feed in Inches per Min. from Feed per Revolution and Spindle Speed.
Cubic Inches of Metal Removed per Min. from Area of Hole and Feed per Min.
Area of Drill
Feed in Inches per Revolution
Diam. of Drill in Inches
Diam. of Drill
Spindle Speed in R.P.M.
Feed in Inches per Minute

DIAGRAM FOR QUICKLY FINDING INFORMATION AS TO DRILL SPEEDS, CUTS, ETC.,

The above chart was presented at the recent convention of the Association of Car Lighting Engineers by J. Henry Klink, of the Westinghouse Electric & Mfg. Co.

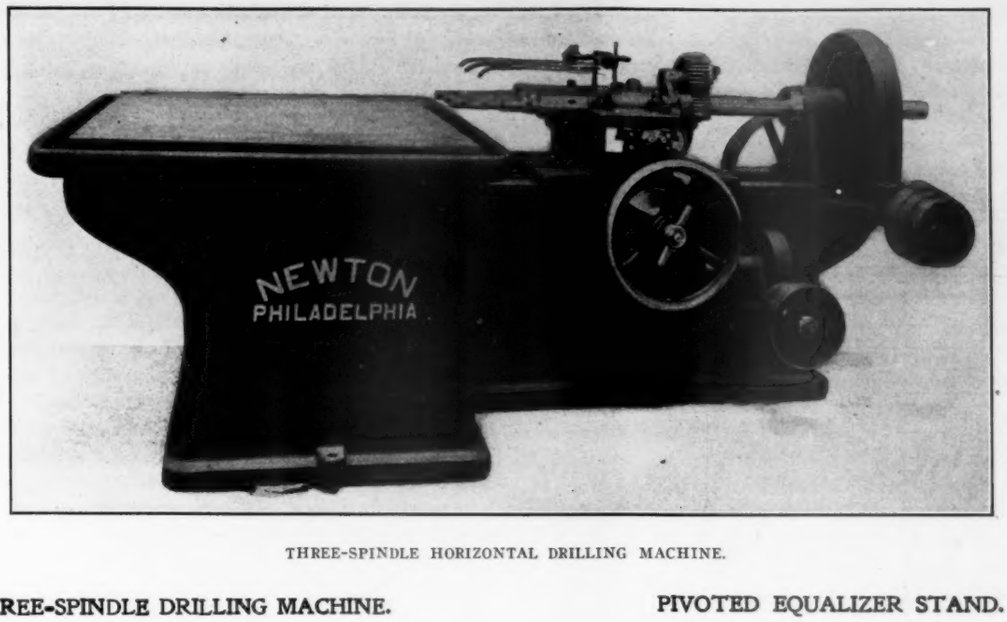
1. To Find Cutting Speed.—From the intersection of the horizontal line corresponding to the diameter of the drill and the vertical line corresponding to the spindle speed, follow the nearest curve and use the value found in the oblique line of the figures marked cutting speed.

2. To Find Feed in Inches per Minute from Feed per Revolution and Spindle Speed.—From the intersection of the horizontal line corresponding to the feed in inches per revolution and the vertical line corresponding to the spindle speed, follow the nearest curve and use the value found in the oblique line of the figures marked feed in inches per minute.

3. To Find Area of Drill from Diameter of Drill, Use Curve on Left Side of Figure.—Find the intersection of the vertical line corresponding to the diameter of the drill with the curve. Follow the horizontal line passing through this intersection and obtain the area under the area of the drill in the vertical column.

4. To Find Cubic Inches of Metal Removed per Minute.—From the intersection of the horizontal line corresponding to the area of the drill and the vertical line corresponding to the feed per minute, follow the nearest curve and use the value found in the oblique line of the figures marked cubic inches of metal removed per minute.

Knowing Diameter of Drill, Spindle Speed and Feed per Revolution.—Find the cutting speed from 1. Find metal removed per minute from 2, 3 and 4.



THREE-SPINDLE HORIZONTAL DRILLING MACHINE.

THREE-SPINDLE DRILLING MACHINE.

The three-spindle drilling machine shown in the illustration is specially adapted for drilling frogs and switches when assembled. The spindles are 1⅞ in. in diameter and are mounted in bushed bearings. The center one is mounted in a fixed bearing and the two outer ones in movable saddles which may be adjusted from a minimum distance of 3½ in. to a maximum distance of 9½ in. between centers.

The carriage upon which the spindles are mounted has three changes of feed and a hand fast and slow movement. The work table is 60 in. wide and 48 in. long. The machine is furnished complete with a pump, piping and attachments for lubrication. The spindles are driven through a bronze spiral gear and a steel pinion. The machine may be driven from a countershaft or by an individual motor. It is manufactured by the Newton Machine Tool Works, Inc., of Philadelphia, Pa.

VANADIUM STEEL FOR FORGING DIES.

Our attention was recently directed to a plant that had been using carbon steel dies in very severe service for hot forging and drawing work. The dies were giving an average service of two days and breaking from crystallization and other defects in the steel. It was decided to try vanadium steel in the hope that the remarkable properties of vanadium in retarding or eliminating crystalization would give the dies a longer period of usefulness. The dies were used in the same manner, by the same man, on the same machine and for the same service as the carbon dies, and at the time of writing had been in use over four months.

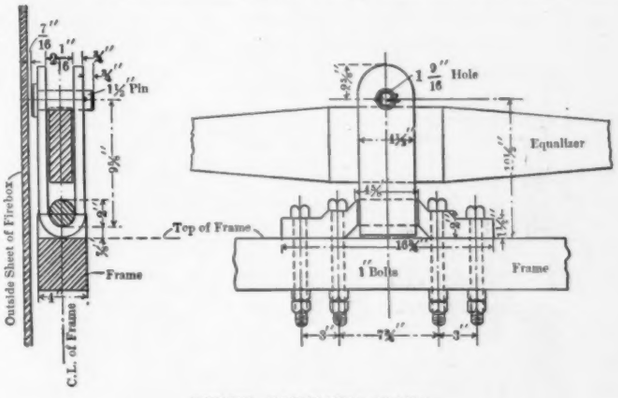
CO-OPERATIVE ENGINEERING COURSES.—You all know about the co-operative course for engineering established three years ago at the University of Cincinnati; boys who have passed through the high schools can enter this six-year course, working one week at the shop and one week at the university, earning, during the period of six years, about $1,800. About 200 of these boys are now employed in Cincinnati shops. While there are exceptions to the rule, as a class these boys have surprised their employers as to the character and quality of work they are able to do. In fact, the experience has been very satisfactory. Right in the beginning there was considerable skepticism on the part of manufacturers and a reluctance to accept these boys. The shops to-day are offering to take on more new men than the university facilities, at present, can take care of.—*Frederick A. Geier, before the National Machine Tool Builders' Association.*

PIVOTED EQUALIZER STAND.

WALTER D. TICKELL.

It has been the experience on some roads, where the track is not maintained in the best of conditions, that the rigid equalizer stand on narrow firebox locomotives is occasionally broken, due to the gib bearing at the stand wearing unequally and getting out of line with the spring hanger bearing. Where this occurs the tendency is to cant the equalizer and the heavy shock from rough track will break off the stand.

On the Yazoo and Mississippi Valley Railroad this trouble has



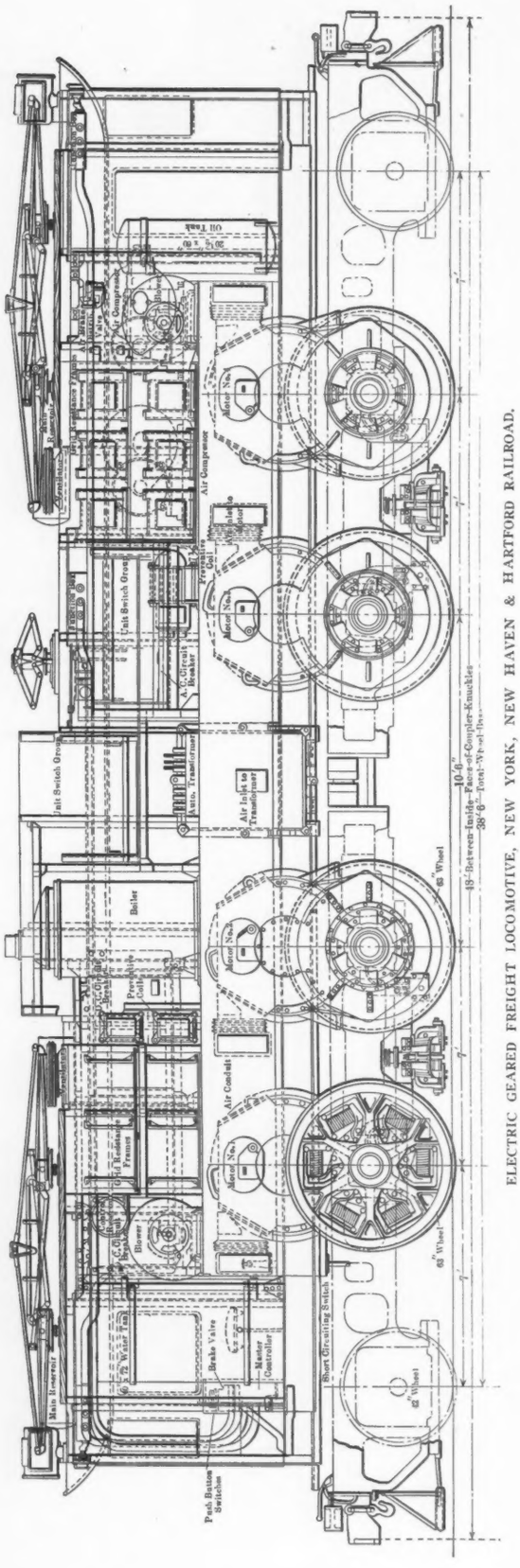
PIVOTED EQUALIZER STAND.

been overcome by a pivoted equalizer stand, which is shown in the accompanying illustration. The construction will be clear from the drawing, the parts being of forgings and requiring very little machine work. This type of stand can easily be arranged for an offset equalizer center and experience has shown that it makes a most satisfactory fulcrum bearing, which costs practically the same to make and apply as does the rigid stand.

FIRES ON PENNSYLVANIA RAILROAD PROPERTY.—1,397 fires occurred in 1908 on Pennsylvania Railroad property valued at more than $260,000,000. It was damaged only to the extent of $346,149. Of these fires, 274 were extinguished by the railroad's employees with the company's own apparatus with slight loss. The reduction of its fire loss to such a minimum means that the railroad has had to make it practically impossible for a conflagration to start in its yards and terminals. It has been working to this end for thirty odd years, and to-day its system of fire protection is said to represent the most extensive and comprehensive undertaking of its kind as yet made by any private corporation.

ELECTRIC GEARED FREIGHT LOCOMOTIVE.

NEW YORK, NEW HAVEN & HARTFORD RAILROAD.



ELECTRIC GEARED FREIGHT LOCOMOTIVE, NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

The Westinghouse Electric & Manufacturing Company has recently completed an electric freight locomotive of large capacity, for use on the electrified section of the New York, New Haven & Hartford Railroad, between Stamford and New York City. The locomotive was designed primarily for handling fast freight service, but will also be used for hauling heavy passenger trains. It will be given a thorough test in the freight service with a view to eventually handling all of this class of work electrically.

The mechanical parts were designed by the Baldwin Locomotive Works, and the mechanical department of the N. Y., N. H. & H. R.R., and were built at the Philadelphia works of the Baldwin Company. The design includes various features of special interest. The general plan of the trucks and running gear has been worked out in accordance with a patent granted to S. M. Vauclain, July 6, 1909. This patent describes an articulated locomotive in which the truck frames are connected by an intermediate draw-bar. One truck has only a rotative motion about its center-pin, while the other has a fore-and-aft as well as a rotative motion, in order to compensate for the angular positions of the trucks and draw-bar, when the locomotive is traversing curves. The tractive force is transmitted through the truck frames and draw-bar, instead of through the main frame.

In the present instance, the 2-4-4-2 wheel arrangement has been adopted. Each truck has two pairs of driving wheels, and a single pair of leading wheels. The driving wheels are held in alignment by cast-steel bar-frames, similar to those ordinarily used in steam locomotive practice. The frames are placed outside the wheels, and are braced transversely under the center of the locomotive by heavy steel castings provided with draw pockets in which the intermediate draw-bar is seated. This bar transmits the full tractive force developed by the motors of the leading truck from one truck frame to the other. Train connections are effected by means of two radial draw-bars, one of which is placed at each end of the locomotive. The draw-bars are pinned to cast-steel cross-ties, which brace the truck frames between the driving and leading wheels. The latter are mounted on radial-swing trucks of the "Rushton" type. The truck radius bars are pivoted to the same cross-ties as the main draw-bars. The wheel loads are equalized as in steam locomotive practice, the springs of the leading wheels being connected to the driving springs by equalizing beams. One of the trucks is cross-equalized under the center of the locomotive. The frame is spring supported by the cross-equalizer, on each side of the center line. This arrangement should promote steady riding, and tends to prevent side-rolling at high speed.

The cab is built of steel plate, and measures 43 ft. 6 in. in length, covering the entire locomotive. The frame that supports the cab is composed of two 12-in. channels, united at the ends by plates and angles. This frame is braced transversely by five cast-steel cross-ties—one over each truck center-pin, one at mid-length, and one near each end of the locomotive. The truck center-pins carry no weight and, as before explained, one of them is allowed a fore-and-aft as well as a rotative motion.

The cab is supported on the intermediate and end cross-ties, the weight being transferred through coiled springs, which are placed in suitable pockets. The cab frame is held in alignment by the truck-center pins, while the lower spring pockets are free to slide over the truck-frame cross-ties. The springs over the end cross-ties are placed 30 in. apart, transversely. The middle cross-tie carries four springs; these are placed at the corners of a rectangle and are 84 in. apart, transversely, and 53 in. longitudinally. As both the trucks are free to rotate about their center-pins, the displacement of the spring pockets, even on a 20-degree curve, is comparatively slight. To assist in reducing shocks and keeping the two truck frames in alignment, chafing castings and spring buffers are interposed between the frames, under the center of the locomotive. It is believed, from experi-

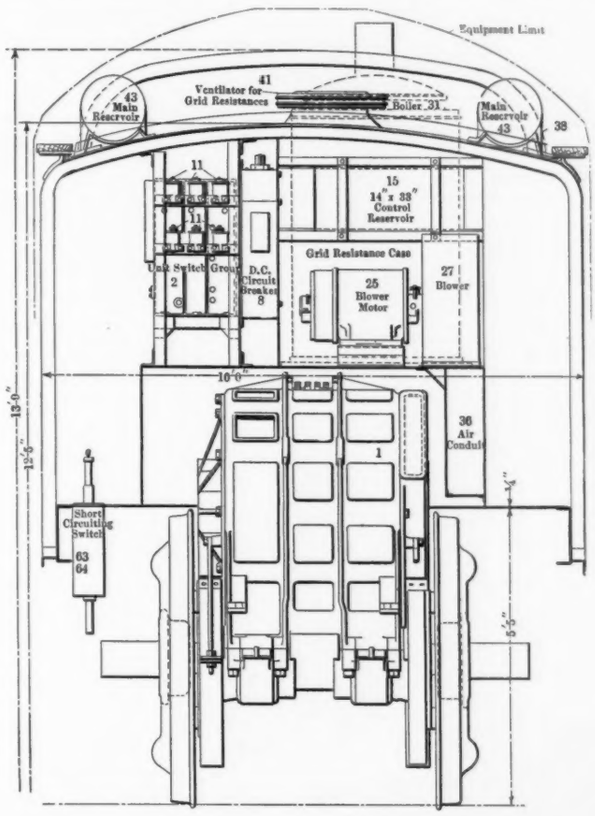
ence gained with previous locomotives, that the plan of running-gear and cab support adopted for this engine, will tend to avoid nosing, promote easy riding and minimize shocks on the truck and roadbed.

The principal dimensions of this locomotive are as follows:

Gauge	4 ft. 8½ in.
Driving wheels, outside diameter	63 in.
Driving wheels, center diameter	56 in.
Driving-axle journals	8 in. x 13 in.
Truck wheels, diameter	42 in.
Wheel-base, rigid	7 ft. 0 in.
Wheel-base, total	38 ft. 6 in.
Length between coupler faces	48 ft. 0 in.
Height over all	13 ft. 9 in.
Width	10 ft. 0 in.
Approximate weight, total	260,000 lbs.
Approximate weight on driving wheels	188,000 lbs.

A characteristic feature of the heavier details is the free use of cast steel. This is particularly true of the truck frame cross-ties, which are interesting examples of mechanical design. The tendency to follow approved steam locomotive practice is also evident in many of the mechanical details.

The electrical equipment, which was built and mounted by the



CROSS-SECTION, NEW HAVEN ELECTRIC LOCOMOTIVE.

Westinghouse Electric & Manufacturing Company, comprises four 350-horse-power single-phase geared motors, together with the necessary auxiliary apparatus for their operation from the 11,000-volt alternating-current or 600-volt direct-current circuits of the electrified sections which the locomotive will traverse. The motors are placed directly over the axles and are mounted solidly on the truck frames. Each end of the armature shaft is provided with a pinion; these mesh with gears mounted on a quill surrounding the axle and carried in bearings on the motor frame, similar to the usual axle bearings. The quills are provided with six driving arms on each end, which project into spaces provided between the spokes in the driving wheels. Each of these arms is connected to an end of a helical spring, the other ends of the spring being connected to the driving wheels.

This arrangement of drive smooths out the torque pulsations, and at the same time allows for vertical movement of the axles. In addition to the spring connection between the quills and drives, flexibility is provided between the pinions and motor shaft, to equalize the torque on the gears. The quills are of large diameter, permitting unrestricted motion of the wheels and axles. The center of gravity of the motors, as well as that of the entire locomotive, is high, avoiding the transmission of strains and shocks from the track and roadbed to the motors.

The motors, of the standard Westinghouse type, have twelve poles built into a solid frame, and are designed for forced ventilation. When operating on 25-cycle alternating-current with forced ventilation, each of the four motors will carry continuously a load of 300 horse-power. An air-blast transformer is provided for lowering the trolley line voltage to that required by the motors. The control apparatus is of the well-known Westinghouse electro-pneumatic type.

When operating on alternating current, all four motors are connected in multiple and the control is obtained entirely by changing the connections to various voltage taps on the main transformer. On direct current the motors are first grouped all in series, and then two in series and two in parallel, in combination with various resistance steps. Provision is made for cutting out any one of the four motors singly on either alternating current or direct current. A master controller and brake valve are located in each end of the cab so that the locomotive can be operated from either end, and the system of control is such that two or more locomotives of this type can be coupled together and operated from one master controller.

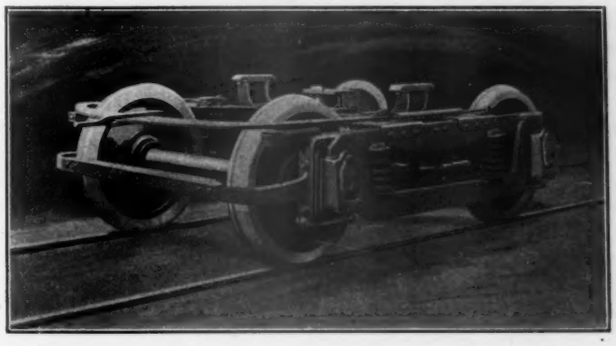
Two pneumatically-operated pantagraph trolleys are provided for collecting current from the 11,000-volt overhead alternating-current line. Pneumatically-operated third-rail shoes are used to collect current on the direct-current third-rail section. A steam heater outfit is provided on the locomotive for heating the cars of the trains, when used in passenger service. The drawings show the arrangement of control apparatus which is located in the center of the cab with a passage on each side. Twenty windows are provided, affording ample lighting of the cab interior.

The locomotive will be capable of hauling a freight train having a maximum weight of 1500 tons, at a speed of 35 miles per hour. When used in passenger service, 800-ton trains will be hauled at a maximum speed of 45 miles per hour.

A NEW TRUCK FOR ELECTRIC CARS

A new truck in the design of which strength, simplicity, rigidity and a thorough consideration of the features of maintenance were the controlling influences is being built by the J. G. Brill Co., Philadelphia, and was shown for the first time at the recent convention at Denver. The accompanying illustrations show its general features and construction.

Each side frame is forged, including the pedestals, in a solid piece, a construction which eliminates built-up work. While the type of frame is similar to the frames which are used for



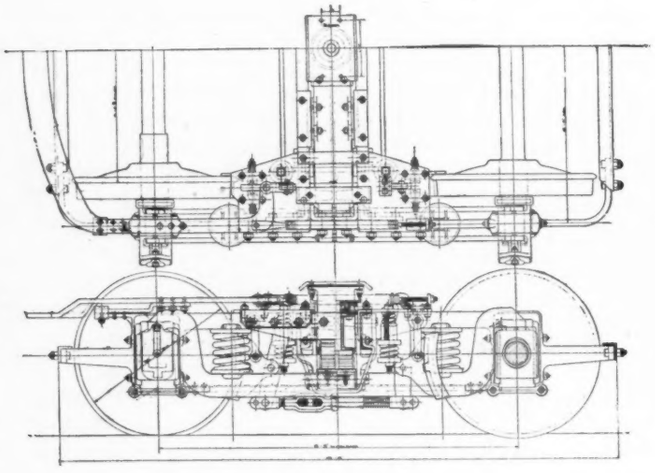
BRILL TRUCK FOR ELECTRIC CARS.

the distinctively Brill types of trucks there are certain essential differences, most notable of which is the reduction of the amount of metal in the truck frame, which makes the No. 27—M. C. B. truck, as it is designated, much lighter than most other high speed trucks of the same size. The reduction of metal and consequent reduction in weight occurs through the reduced di-

mensions of the pedestal yokes and end crossings which is made possible because of the forged construction and because the load upon the truck is brought to the journal boxes through the equalizing springs and equalizing bars, so that the truck frame beyond the point of support on the equalizing springs is not subject to heavy load or severe strains except those which occur when the truck enters a curve at high speed. In the design of the frame, the top of the yoke and the top of the frame have been placed in alignment and the extensions to which the angle iron end crossings are bolted are placed in line with the axle centers.

The transom construction is most substantial. The deep channels which are employed for this purpose are held in position by wrought single and double corner plate brackets and wrought gusset plates. The gusset plate construction in particular has been given special attention as the squareness of the truck depends to a large extent on the construction at this point. The plates are of ample dimensions for the most severe strains, and are folded over the side of the forged frame and bolted to the frame with bolts which also pass through the wrought plate brackets. This method of bolting the gusset places the minimum number of bolts in shear and secures unusual strength and rigidity.

One of the weak points of many M. C. B. trucks has been the tie bar construction, and the construction at this point in



TRUCK FOR ELECTRIC CARS.

this design, it is believed, is a marked advance. Channel tie bars connect the inner pedestals and short tie bars connect each pair of pedestals. The tie bars are bolted through the frame in such a manner that they form a rigid reinforcement to the pedestals and, by a simple device, absolutely remove the shearing strain from the bolts. The short tie bars can be readily removed and the wheels and axles dropped.

The bolster is cast steel, including the lugs for the side bearings, and rests on two elliptical springs which in turn bear on two part castings in such a manner that shims can be readily placed between the springs and the castings to compensate for wheel wear or settling of the springs. The chafing plates on the bolsters and transoms can be taken off and renewed without removing the bolster from the truck. Both of these features are designed to reduce maintenance charges. An additional feature of the bolster chafing plate is its ample vertical dimension which secures better support to the bolster against tilting and insures uniformity of wear.

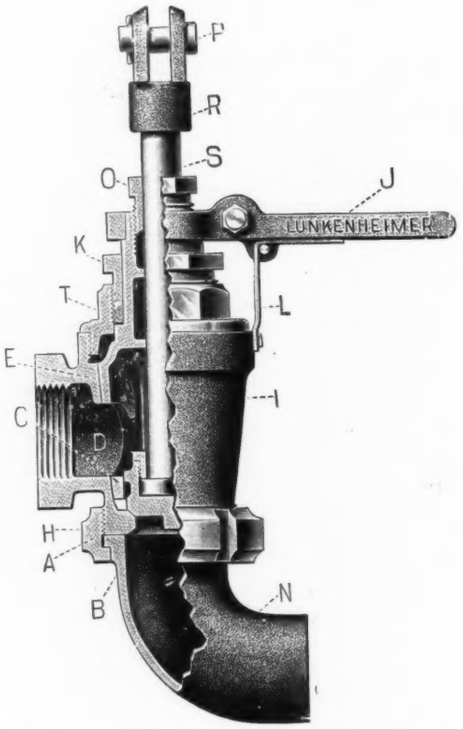
The construction of the end crossings is an interesting detail. The crossings, which serve as an extra safeguard in holding the truck square, are angle irons and are bolted to the extensions of the side frames. The side frame extensions are curved around for extra clearance and present a broad surface where they are bolted to the angle iron crossings, which secures increased strength at this point.

The manner in which this truck has been developed during the past three years, it is believed, has eliminated all experimental features.

LOCOMOTIVE BLOW-OFF VALVE.

The detail construction of the Lunkenheimer improved locomotive blow-off valve is shown by the accompanying illustration. In its construction is involved the use of two distinct valves within a single body: one of these is for regular use, while the other is provided for emergency service, to be operated only in case of possible failure of the main valve. This emergency provision is the means of avoiding considerable annoyance and expense. The valve is operated by hand, and is so constructed as to eliminate all tendencies to fouling, sticking or leaking; it is positive in every action.

Connection to the boiler is made at D, while the outlet from the valve is through the malleable iron ell terminating at N. The main disc and seat are at the lower end of the stem S, the



LUNKENHEIMER LOCOMOTIVE BLOW-OFF VALVE.

operation of the former being effected by vertical movement of the stem S, through suitable levers attached to the fork P, and carried to a readily accessible point on the running board. By lifting the main valve as high as it will go, full and uncontracted area is provided for the blow-off passage from C to B. The emergency feature, for use in case of possible failure of the main valve, is provided in the key or taper plug valve E, made a ground fit in the body I and operated when required by rotation of the lever handle J. Ordinarily, this emergency key remains in the open position, as shown, giving free passage through from the inlet to the main valve. Should the latter leak or give trouble in any respect, preventing its tight closing, the key may be rotated to close the inlet opening. Then the main valve is raised to its extreme open position and all blowing-off operations are performed by manipulation of the emergency valve. The main valve should be restored promptly to working condition, so as to release the key plug for its intended function as an emergency feature.

Stuffing-boxes at O and K insure against leakage around the stem S of the main valve or the neck of the emergency key. The lever handle J is held firmly in either open or closed

position by the spring L, which engages suitably placed notches in lugs on the body I. Immediately above the valve disc D is formed a flange, not only guided by ribs as the valve is raised and lowered, but also providing for positive cleaning of the seat A as the valve is closed. This flange fits loosely within the key, being a few thousandths of an inch smaller in diameter. When, therefore, the lower edge of this flange approaches and passes the edge of the key opening, there is caused a gradual wire-drawing of the escaping water, more and more of which bursts at once into steam, and, by its high velocity, becomes quite effective in washing away any sediment which may have collected on or near the seat. A serious cause of trouble is thus eliminated. If the sediment is not removed it prevents the proper seating of the disc and allows slight leakage, which rapidly increases as the resultant cutting action progresses. Serious injuries, also, are often caused by attempts to close tight a blow-off valve upon whose seat has lodged a piece of boiler scale or other hard substance, thus possibly ruining both the disc and the seat. Should a piece of boiler scale become lodged in the opening and prevent closure of the main valve, it may generally, by a partial turn of the emergency key, be so broken up as to pass out in fragments when the key is returned to the open position. Practical service has shown several points of peculiar advantage creditable entirely to the double character of this blow-off valve. It can also be reground readily should the seat become worn. As all parts of the valve are made to standard gauges and templets, any worn out or broken part can be quickly renewed.

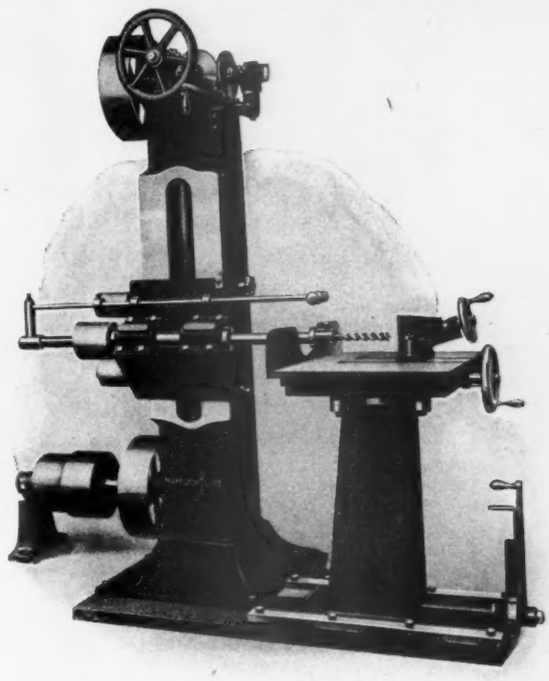
The passages at all points are fully equal to the connecting pipe. Thus the flow of water is entirely free and quite direct. Should the water in the boiler foam while on the road, the engineer or fireman can open the blow-off by reaching out on the running board to the operating lever. These valves are in use on a number of railroads and the Boston & Maine has adopted their use in connection with the cleaning out or flushing of ash pans. It is manufactured of a high grade of bronze composition, insuring strength and durability, by the Lunkenheimer Company, of Cincinnati, Ohio.

SINGLE SPINDLE HORIZONTAL CAR BORING MACHINE

The single spindle universal horizontal car boring machine, shown in the illustration, is designed for boring heavy timbers and is specially valuable because of its adaptability to meet various requirements as to size, depth, position and angle of holes. The column is substantial and has planed dovetailed slides on its front, forming the support for the boring spindle carriage which is gibbed to the column slide.

The boring spindle rests in a secondary sleeved spindle which carries the driving pulley at its end, the sleeved spindle thus never coming in contact with the journal boxes, preventing irregularity of wear. The boring spindle carriage has vertical adjustment, being raised and lowered by means of a power feed screw operated by a friction drive controlled by a hand lever, or by the hand wheel; thus it is raised and lowered to any desired height either by hand or power feed. The driving belt remains uniformly taut in all positions. The boring spindle has a horizontal stroke or movement of 15 in., being brought forward by hand. The square column table stand which carries the turning and sliding straight, or angular boring table, is supported on the base plate of the machine and is adjustably attached to it by means of double dovetail slides, so that it can be placed at various distances from the main column. This adjustment is accomplished by a screw motion operated by a lever arrangement with ratchet and pawl.

The sliding and turning straight and angular table is supplied with a dovetail slide, a screw feed, and a radial dovetailed disk upon which the table turns for angular boring, thus enabling the operator to make a close adjustment of the material in relation to the boring spindle, and providing for end and angular boring. The table has an excellent and convenient adjusting guide fence and clamp for holding the material. A hand and power feed roller table, about 10 ft. long by 27 in. wide, can be furnished with this machine instead of the column table described. It will clamp 22 in. wide by 16 in. thick and carries six rollers, the central one being fluted and supplied with a hand wheel feed, the center and two end rolls being geared together by a chain and driven by either hand or power feed. The col-



HORIZONTAL UNIVERSAL CAR BORING MACHINE.

umn table is recommended for short material and angular boring only, while for long material and straight boring the roller table is more desirable.

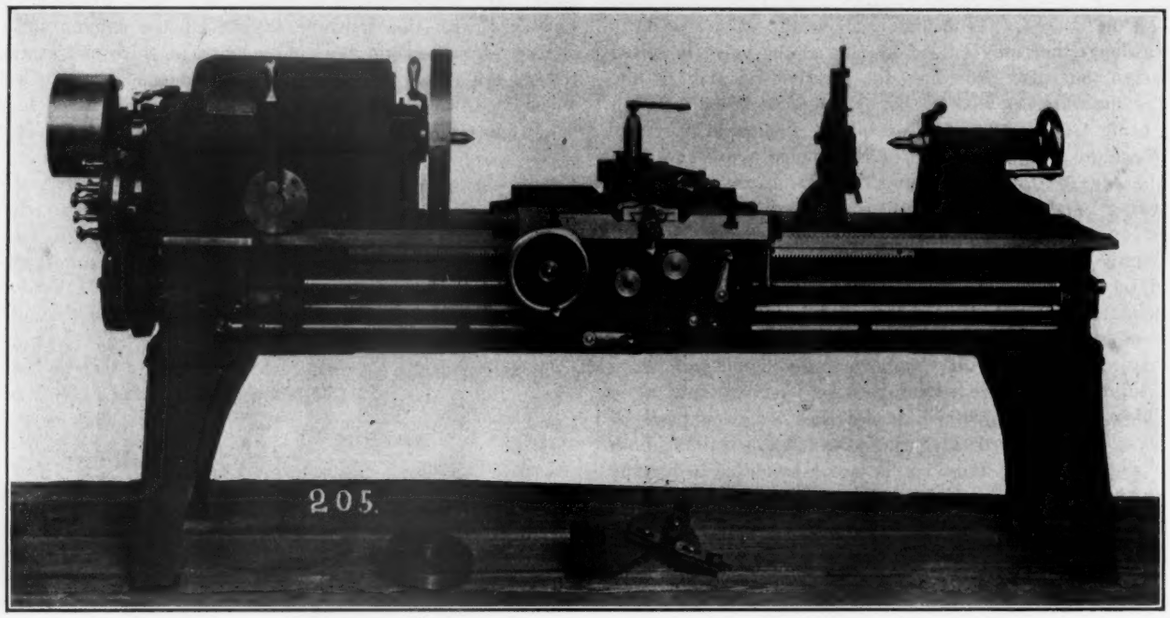
The machine, fitted with a roller table occupies a floor space of 7 by 10 ft., and with the column table 7 by 3 ft. It requires 5 h. p. for driving and weighs 2,100 lbs. with the column table and 3,600 with the roller table. It is manufactured by The Bentel & Margedant Company, Hamilton, Ohio.

BOOK NOTES.

Methods of the Santa Fe—Efficiency in the Manufacture of Transportation. By Charles Buxton Going. 124 pages, 6½ x 9½ in. Published by *The Engineering Magazine*, 140 Nassau street, New York City. Price, $1.00.

About a year ago Mr. Going, editor of *The Engineering Magazine*, made a five weeks' trip over the Santa Fe in order to study the betterment work closely. As a matter of fact *The Engineering Magazine* is the only journal, other than the AMERICAN ENGINEER AND RAILROAD JOURNAL, that has seemed to grasp the importance of the work on the Santa Fe and to closely follow its development. Mr. Going's observations appeared in his magazine in five installments under the following titles: Peculiar problems of the road and their solution; the stores-keeping, shop order and works-order systems; manufacturing policies for the economical maintenance of motive power; administration, supervision and extension of the bonus system; the apprentice system and relations with employees. The demand for the numbers containing these articles has made it necessary to reprint them in book form.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The thirtieth annual meeting will be held in the Engineering Societies Building, 29 West Thirtieth-ninth street, New York, December 7 to 10.



ENGINE LATHE WITH AN ALL-GEARED HEAD.

ALL-GEARED HEAD LATHE.

An 18-inch lathe with an all-geared head, manufactured by The Hamilton Machine Tool Company, Hamilton, Ohio, is shown in the illustration. Twelve spindle speeds are provided, using a single speed countershaft, any one of which may be obtained easily and quickly. The arrangement of the headstock is quite simple; the driving pulley is placed on the end of the back gear shaft, relieving the spindle of the strain due to the pull on the belt. The driving pulley is of good diameter and wide face and the driving mechanism is such that ample power may be transmitted at all spindle speeds.

A friction clutch, operated by the lever at the left of the headstock, makes it possible to stop the driving mechanism instantly, allowing the driving pulley to run idle. The gears are engaged by shifting those on the spindle to the right or left, as required, by means of the lever at the front of the head. No clutches are used between these gears, which engage by direct contact, and when throwing them in the friction clutch should be disengaged. This operation is practically instantaneous, consequently no time is lost in changing speeds, and the omission of additional clutches greatly simplifies the construction, making it less liable to get out of order and providing a more positive drive. A plate on the headstock shows the different speeds available and the correct position of the levers for each. The spindle is of crucible steel, of large diameter, and runs in hard phosphor bronze boxes. The gears required are ten in all, only four being employed at one time. They are of wide face and coarse pitch, accurately cut, and run smoothly and without excessive noise. The headstock is cast in two parts, the lower section forming a reservoir in which the speed changing gears are constantly immersed in oil. The upper part is securely bolted in position, forming a brace which effectually prevents vibration under heavy cuts; at the same time it can be quickly taken off, leaving the gearing entirely exposed.

A motor drive may be applied, if desired, the usual practice being to mount a constant speed motor over the headstock and connect it directly to the driving shaft. This all-geared head may be furnished on Hamilton lathes from 14 to 36 inch in size.

PERSONALS.

T. W. Jackman has been appointed master mechanic of the Montana division of the Oregon Short Line, with office at Pocatello, Idaho, succeeding Henry Carrick, retired.

G. W. Lillie has been appointed superintendent of the new shops of the St. Louis and San Francisco Railroad at Springfield, Mo. The office of supervisor of car department has been abolished.

Samuel G. Thomson has been appointed assistant engineer of motive power of the Philadelphia & Reading Ry. and subsidiary lines, with office at Reading, Pa. The positions of mechanical engineer and electrical engineer have been abolished.

J. F. Enright, superintendent of machinery of the International & Great Northern Ry. at Palestine, Tex., has been appointed superintendent of motive power and car department of the Denver & Rio Grande R. R., with office at Denver, Colo.

W. L. Jones, general foreman car repairs, of the St. Louis-Louisville lines of the Southern Ry. at Princeton, Ind., has been appointed general foreman car department, of the St. Louis, Brownsville & Mexico Ry., with office at Kingsville, Tex.

Eli Emory Hendrick, president of the Hendrick Manufacturing Company, Carbondale, Pa., died on Monday, October 25th.

W. T. Dorman has been appointed road foreman of engines of the St. Louis & San Francisco R. R., with office at De Quincey, La.

W. C. Steers has been appointed assistant master mechanic of the Cincinnati, Hamilton & Dayton Ry. at Lima, Ohio, succeeding J. J. Kelker, resigned.

Thomas Mahar has been appointed master mechanic of the Harlem division of the New York Central & Hudson River R. R., succeeding H. B. Whipple, resigned, and also master mechanic of the Putnam division on account of duties transferred from the master mechanic of the Hudson division; his office is at White Plains, N. Y.

John G. Neuffer, formerly superintendent of machinery of the Illinois Central R. R., the Yazoo & Mississippi Valley R. R. and the Indianapolis Southern Ry. at Chicago, has been appointed superintendent of motive power of the Chicago Great Western R. R., with office at Chicago, succeeding W. E. Symons, assigned to special service.

J. N. Mowery, mechanical engineer of the Lehigh Valley R. R. at South Bethlehem, Pa., has been appointed an assistant master mechanic of the Auburn division, with office at Auburn, N. Y.

J. W. Small, superintendent of motive power of the Southern Pacific of Mexico and the Sonora Railway at Empalme, Sonora, Mex., having resigned, that office is now abolished and all reports previously made to the superintendent of motive power will hereafter be made to R. H. Ingram, assistant general manager at Empalme.

J. D. Conway, chief clerk to the superintendent of motive power of the Pittsburg & Lake Erie R. R. at Pittsburg, and secretary of the Pittsburg Railway Club, has been elected secretary of the Railway Supply Manufacturers' Association. He will have charge of the renting of space for exhibits at the convention in Atlantic City next year and will be located at the offices of the association in the Old Colony Building, Chicago.

J. A. Tuttle and J. F. Nally, formerly master mechanic and traveling engineer, respectively, of the Colorado division of the Union Pacific Railroad, have in accordance with the new organization on that railroad been appointed assistant superintendents. They are still charged with the responsibilities before devolving upon them, and in addition will assume such other duties as may be assigned to them from time to time. All communications intended for them in their official capacity will be addressed simply to the assistant superintendent, Denver, Colo.

John Caldwell, treasurer of the Westinghouse Air Brake Company, was stricken with heart disease and died in his office Tuesday morning, November 23, before a physician could reach him. Mr. Caldwell was one of the trusted lieutenants of George Westinghouse, with whom he had been associated since the inception of the Westinghouse Air Brake Company. He was born in Ireland about seventy years ago, his father being a Presbyterian minister. He came to Pittsburgh when twelve years of age and followed mercantile lines until 1869, when the air brake company was organized, he then taking a position as bookkeeper, which place he retained for ten years. He was director and vice-president of the Bank of Pittsburgh and a trustee of the Carnegie Institute since its foundation. Mr. Caldwell was a Scottish Rite Mason and a member of the Royal Legion. He enlisted as a private in the 61st Pennsylvania Volunteers during the Civil War and was mustered out as a second lieutenant. He had a world-wide reputation as an art connoisseur and a collector of rare books, his collection being claimed as one of the most valuable in existence. In addition to a widow he leaves a son, daughter and sister.

Peter H. Peck, for twenty-one years master mechanic of the Chicago & Western Indiana and Belt Railroad of Chicago, who was granted a leave of absence from that position in August, 1908, has resigned his office and has been appointed secretary and treasurer of the Belt Line Coal Company, with office at Chicago. Mr. Peck was born November 28, 1844, at Cerro Gordo, Ill., and was in the Union army from 1862 to 1865, taking part in fourteen battles in the Tennessee and Atlanta campaigns. He began railway work in July, 1865, as locomotive fireman on the Des Moines Valley Railway and later was engineman on the Keokuk & Des Moines, both of which roads are now a part of the Chicago, Rock Island & Pacific. In January, 1876, he went to the St. Louis, Keokuk & Northwestern, now a part of the Chicago, Burlington & Quincy, and in 1878 to the Hannibal & St. Joseph, now also a part of the Burlington. In November, 1882, he was made division master mechanic of the latter road, in which position he remained for five years, becoming master mechanic of the Chicago & Western Indiana and Belt railways in May, 1887. He was president of the Western Railway Club in 1903, was president of the American Railway Master Mechanics' Association in 1905, and of the Car Foremen's Association in 1908.

R. C. Burns has been appointed general air-brake and steam-heat inspector of the Pennsylvania R. R., attached to the office of general superintendent of motive power at Altoona, Pa. He will confer with superintendents of motive power, master mechanics, general foremen and others on questions relating to his duties. His territory includes the Philadelphia, Baltimore & Washington R. R., Northern Central Ry. and West Jersey & Seashore R. R.

Dr. Ernst J. Berg, of Schenectady, has been appointed professor of electrical engineering, in charge of the department at the University of Illinois. Dr. Berg was born in Sweden in 1871. He graduated from the Royal Polytechnical Institute at Stockholm in mechanical engineering in 1892, and came to the United States in 1893. For the past seventeen years he has been associated with the General Electric Company, lately as expert advisor. It is announced that Professor Morgan Brooks, who is now absent on leave for foreign study, and is succeeded by Dr. Berg, will return to the University upon the expiration of his leave, as a professor in the same department.

CATALOGS.

PLEASE MENTION THIS PAPER WHEN WRITING FOR THESE CATALOGS.

BELTING.—The Peerless Belting Co., Buffalo, N. Y., is issuing a leaflet giving price lists and tables showing the amount of power transmitted by belts of different widths, and other handy rules in connection with belting.

NIPPERS AND PLIERS.—The Utica Drop Forge & Tool Co., Utica, N. Y., is issuing a pamphlet, printed in two colors, showing pliers and nippers in practically all styles and sizes. Each different style is very well shown by the illustration and is accompanied by prices. The catalog is titled "Plier Palmistry."

GAS ENGINE AIR COMPRESSORS.—A self-contained unit comprising a gas engine and air compressor, both of which can be of any pracical size, is illustrated in a catalog being issued by the Flickinger Iron Works, Bradford, Pa. The details of the machinery are fully described. Other direct-connected sets consist of a gas engine connected to a pump.

"CELLO" STEEL is more dense than ordinary tool steel, and is made specially for dies, taps, reamers and any special tools where better results than can be obtained with the use of the ordinary tool steel are desired. It does not require any special treatment for hardening. The McInnes Steel Co., Ltd., Corry, Pa., is issuing a leaflet briefly stating what this steel is good for and how it should be treated.

HOISTING MACHINES.—Chain hoists, trolleys, traveling cranes, etc., are the subject of a catalogue being issued by J. C. Speidel, of Reading, Pa. This catalog contains illustrations and descriptive matter of a number of designs particularly suited for railroad shop uses. It shows trolley hoists for capacities up to 40,000 lbs., and includes turn-tables, switches and similar arrangements for this type of hoist. Hand and power cranes, elevators, etc., are considered.

VISES.—A booklet giving illustrations and tables of dimensions, weights and prices of a very complete line of vises for either wood or metal work, is being issued by the G. M. Yost Mfg. Co., of Meadville, Pa. This booklet also includes a brief description of the "Uwanta" wrench, which is claimed to be unequaled in its utility to stand punishment. Also a very handy adjustable holder for incandescent electric lights and an emergency clamp for repairing leaks in iron piping.

A NEW WRENCH.—Rogers, Printz & Co., Warren, Pa., have designed a new type of adjustable wrench, which is also made as a pipe wrench, that embodies the wedge principle altogether for locking. It is quickly and easily adjustable to any size bolt or pipe within its range, and the greater the stress put upon it the more securely it is held in place. It contains but three parts and can be released or adjusted by the thumb, being easily operative with one hand.

VALVES.—The Bashlin Co., Warren, Pa., is issuing a booklet illustrating globe valves designed with renewable discs and seat rings, the latter being arranged to be changeable when the valve is under pressure. For completely renewing the wearable parts of the valve it is not necessary to remove the valve body from the piping. The same system is used in check valves, blow-off valves and faucets. The booklet fully illustrates and describes the features of these valves and includes tables of prices.

BLOW-OFF VALVE.—The Lunkenheimer Company, Cincinnati, Ohio, is issuing an attractive pamphlet describing and illustrating in detail an improved form of locomotive blow-off valve.

BOILER TUBE EXPANDERS.—Self-feeding and self-releasing boiler tube expanders, operated by power or hand, with which it is impossible to overroll and ruin a tube, are the subject of a leaflet being issued by W. H. Nicholson & Co., Wilkesbarre, Pa. The same firm are also sending out a leaflet on expanding lathe mandrels.

HYDRAULIC WHEEL PRESSES.—Simplicity in construction and convenience in operation are the special features on which the design of hydraulic wheel presses of all sizes manufactured by E. R. Caldwell & Co., Bradford, Pa., are based. A noticeable feature of this design is the location of the parallel bars, which are placed at a slight angle to permit the handling of the work with an overhead crane. Safety valves are provided to prevent overloading on all presses of 200 tons or more. A small catalog illustrating and describing this design, and including a table of full dimensions and weights, is being issued by this company, whose address is 34 Hilton street.

BLOW-OFF VALVE.—A new blow-off valve for locomotive and stationary boilers, which has a number of specially good features, is being manufactured by the Monarch Machine Works, Altoona, Pa. This valve has a seat which is fully protected when it is open. It operates with a quarter turn either way, has a very free discharge, and is provided with a renewable seat and disc. It is practically self-grinding in service and does not have to be removed from the boiler for repairs. One of these valves has been in constant service for over three years on a stationary boiler without costing anything for repairs and appears to be capable of giving a number of years further service without trouble. This valve is called the "Riggin" blow-off valve.

WATER TREATMENT.—A handsome souvenir booklet on water treatment has been received from the Dearborn Drug & Chemical Works, Postal Telegraph Building, Chicago, Ill. The preface directs attention to the fact that the average thickness of locomotive boiler scale is 1/16 in., which means a loss of at least thirteen per cent. in fuel efficiency; for the fifty-one thousand locomotives in this country this would mean an annual loss of fifteen million tons of coal. The booklet describes in detail the laboratories and the facilities which the company has for studying water treatment and includes three sections describing the methods used for locomotive, stationary and marine boiler water treatment. Several pages are devoted to a description of the lubricating department.

GRAPHITE LUBRICANT.—A leaflet being issued by the International Acheson Graphite Co., of Niagara Falls, N. Y., draws attention to the value of pure graphite as a lubricant, it being, in this case, blended with a high grade grease which acts simply as a carrier. The process for making unctuous graphite was discovered in 1906, with the result that a graphite can be obtained which is an absolutely perfect lubricant and contains no grit or impurities of any kind. It is made in an electric furnace of over 7,000 degs. F., and is not affected by heat or cold: cannot be decomposed and is not affected by acids and alkalies. A chart is included giving the results of tests with oil and graphite as a lubricant. This is in the form of a curve showing the coefficient of friction. The same company is also issuing a reprint of an address delivered before the American Academy of Arts and Science of Boston on the occasion of the presentation of the Rumford medal to Edward G. Acheson, president of this company, for his electric furnace products. This paper is titled, "Seventeen Years of Experimental Research and Development," and explains how carborundum was discovered, and also how the unctuous graphite used in the lubricants is produced. This paper reviews some of the most interesting and important phases of scientific development during the past decade.

PIPES AND FITTINGS.—One of the finest catalogs that it has ever been our pleasure to examine is being issued by the National Tube Company, Frick Building, Pittsburgh, Pa. It is called catalog H and relates to the product manufactured at the Kewanee works of this company, embracing wrought pipe for steam, gas, water and air; cast, malleable iron and brass fittings, brass and iron body valves and cocks, radiators and coils, etc. The index, which opens the book, covers 28 pages, and is as complete as it is possible to make it. All articles are fully cross-indexed and it will be practically impossible not to find anything shown in the catalog no matter by what name it might be known, or under what head it might be sought. Each product is illustrated by a half-tone from beautifully retouched photographs, and tables, giving full dimensions and prices of each size manufactured, are included in each case. A particularly attractive section of the book is that showing the Kewanee unions and specialties, which is printed in three colors. When it is stated that the catalog occupies 470 pages, it will be understood that it is a full exposition on the subject with which it deals. The type matter is printed in a pleasing shade of green, which is much easier on the eyes than black. The illustrations, however, are printed in black ink. The catalog is most beautifully bound in flexible covers, and has gold edges.

FUEL TESTS WITH ILLINOIS COAL, issued as Circular No. 3 of the Engineering Experiment Station of the University of Illinois, presents the results of an elaborate series of tests conducted at the fuel testing plant of the United States Geological Survey. The circular is compiled by L. P. Breckenridge and Paul Diserens. It deals only with coals taken from mines within the State of Illinois. The investigations described include steaming tests under boilers, gas producer tests, washing tests, coking tests, briquetting tests, and tests to determine composition and heating value. From the results stated it appears (1) that the average calorific value of Illinois coal (ash and moisture free) is 14319 b.t.u.; (2) that its evaporative efficiency is but slightly affected by the moisture it contains; (3) that its evaporative efficiency decreases as the ash and sulphur content increases, and that when burned in a hand-fired furnace its evaporative efficiency decreases as the amount of fine coal contained in it increases; (4) the performance of Illinois coal in a gas producer compares favorably with that of any other bituminous coal tested at the U. S. G. S. laboratory; (5) one-fourth of all the samples tested may be used for the manufacture of coke; (6) briquetting improves the evaporative efficiency of Illinois coals only when the raw coal is in the form of slack or screenings. Copies of the circular may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

NOTES

THE BUDA COMPANY.—The Buda Foundry & Manufacturing Company will hereafter be known as The Buda Company. There will be no change in the organization.

T. H. SYMINGTON COMPANY.—It is announced that this company has purchased the Farlow draft gear, which device will be included among the specialties now manufactured by them.

PRESSED STEEL CAR COMPANY.—The offices of the Pressed Steel Car Company and the Western Steel Car & Foundry Company for the southern district will be removed from Atlanta, Ga., to the Munsey Building, Washington, D. C., on December 1st, 1909. L. O. Cameron, manager of sales, will be in charge.

THE AMERICAN SPECIALTY COMPANY of Chicago has recently been appointed sole export agent for the line of portable electric drilling machines manufactured by the Van Dorn Electric & Mfg. Co., of Cleveland, Ohio. They also have the agency for these tools in the Chicago and central western districts.

MOTORS FOR THE LONG ISLAND RAILROAD.—The West Pittsburgh shops of the Westinghouse Elec. & Mfg. Co. are beginning to work on an order of railway motors for the Long Island Railroad, which represents almost $1,000,000, and calls for 260 motors of 200 h. p., which are to be used for equipping a number of the cars on the Long Island R. R. System.

COMMONWEALTH STEEL COMPANY.—R. L. McIntosh, assistant mechanical engineer of the Missouri Pacific Railway, has resigned to enter the employ of the Commonwealth Steel Company at their Granite City shops. Mr. McIntosh was born in Milwaukee in 1879, graduated from The College of the City of New York in 1901, and served as special apprentice in the Susquehanna shops of the Erie Railway; then as a mechanic in the West Milwaukee shops of the C. M. & St. P. Ry.; from 1901 to 1905 he was employed by the Northern Pacific as material inspector, engineer of tests, mechanical office assistant and shop assistant. He was made assistant mechanical engineer of the Missouri Pacific in 1906.

THE SCHERZER ROLLING LIFT BRIDGE COMPANY.—This company, with general offices in the Monadnock Block, Chicago, Ill., announces the receipt of several important orders for Scherzer rolling lift bridges, including one from the Baltimore & Ohio Railroad for the longest double track single leaf bascule bridge yet constructed. The Seaboard Air Line has recently installed a single track bridge of this type having a movable span of 196 ft., and another one is being constructed across the Savannah River; the San Pedro, Los Angeles & Salt Lake Railroad has just completed the longest single track bridge of this type on the Pacific coast. In addition to these, a bridge at Galveston, and several smaller ones, the company has recieved a number of foreign orders.

WESTINGHOUSE ELECTRIC & MFG. CO.—S. L. Nicholson has been appointed general sales manager and has direct charge over the sales policies of the entire company. He has been with the company for eleven years in many different capacities, as salesman, as district department manager, and as industrial and power sales manager. He was the organizer and is the president of the American Association of Motor Manufacturers, an organization which has done much in the two short years of its life to improve the art of manufacturing motors.

Charles Robbins, who has for many years been connected with the industrial and power sales department in connection with the sale of industrial motors, has been appointed manager of this department.

G. Brewer Griffin has been appointed manager and is actively directing the sales policy of the detail and supply sales department, in which department transformers, meters, fans, heating appliances, switches, switchboards, railway line material, etc., are sold. He has been assistant manager of this department for six years past.